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User Guide

iSBEM

An Interface for SBEM (Simplified Building Energy Model)

Part of the National Calculation Methodology : SBEM for assessing the Energy Performance of Buildings

A User Guide to iSBEM

UK Volume

iSBEM version 3.5.a

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Key changes and additions from previous versions of the User Guide

Changes and additions in 4th June 2010 version 3.5.a:

Further guidance

1. Further explanation or clarification of **existing** parameters and functionality of iSBEM. *This **"Further guidance"** icon shown in the left margin is used to indicate these items in the text.*

    - Commercial EPC conventions added. These are conventions agreed between Accreditation Schemes and endorsed by CLG, in order to encourage consistency between EPC ratings generated by different assessors trained by different schemes. These conventions appear in text boxes at appropriate places in this User Guide with further information in APPENDIX G: Agreed convention for decision on assessment level and APPENDIX H: Agreed convention for determining dimensions.
    - Guidance on definition of the Reference building (see Section 2.3: Calculation basics for UK Energy Performance Certificate purposes).
    - Guidance on zoning rules (see Section 3.3: Zoning guide – How to zone your building).
    - Guidance on using the multiplier parameter (see Section 6.1: Basic interface functionality and buttons).
    - Owner details, instead of occupier details, are required in the General form > General Information tab > Project Details sub-tab (see Section 7.3.2: General Information tab).

- Guidance on the tick box for naturally ventilated building in Scotland in the General form > General Information tab > Project Details sub-tab (see Section 7.3.2: General Information tab).
- Guidance on zone defined as having no HVAC system (see Section 7.5.3: Defining zones – Zones tab and Section 7.6.8: Defining the zone specific building services- Zones tab).
- Guidance on envelope areas (see Section 7.5.4: Defining envelopes – Envelope tab, Section 7.5.5: Defining windows and rooflights – Windows & Rooflights tab, Section 7.5.7: Defining doors – Doors tab, and Section 7.5.8: Quick Envelopes tab: Short cut to creating envelopes and windows).
- Guidance on the window and rooflight parameters which cannot be edited using the Quick Envelopes sub-tab (see Section 7.5.8: Quick Envelopes tab: Short cut to creating envelopes and windows).
- Guidance on bivalent calculation (see Section 7.6.2: Defining HVAC Systems – HVAC Systems tab).
- Guidance on default efficiency for heat generator for hot water systems (see Section 7.6.3: Defining HWS – HWS tab).
- Guidance on default storage and secondary circulation losses for hot water systems (see Section 7.6.3: Defining HWS – HWS tab).
- Guidance on defining solar energy systems (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- Guidance on defining CHP generators (see Section 7.6.7: Defining the CHP generator – CHP Generator tab).
- Guidance on accessing the error files from the Ratings form (see Section 8.1.1: Building Regulations Check tab and section 8.1.2: Asset Rating tab).
- Guidance on activation codes and connection to EPCgen.net (see APPENDIX E: Activation codes and connection to EPCgen.net).

NEW

2. Changes related to **new functionality** of the iSBEM version **3.5.a**. *This **"new"** icon shown in the left margin indicates in the text where iSBEM has changed since the previous version.*

- Version number of iSBEM is now visible in the top blue bar of the window in all forms, tabs, and sub-tabs of the interface (see Section 5.1: Introduction to the main forms in iSBEM).
- New drop-down menu for the related party disclosure parameter in the General form > General Information tab > Project Details sub-tab (see Section 7.3.2: General Information tab).
- New parameter for transaction type in the General form > General Information tab > Project Details sub-tab (see Section 7.3.2: General Information tab).
- New option of "Same space" for the parameter "Connects space to" in the definition of envelopes in the Geometry form > Envelope tab > General sub-tab (see Section 7.5.4: Defining envelopes – Envelope tab).
- New parameter for frame factor of windows in the Geometry form > Windows & Rooflights tab > General sub-tab (see Section 7.5.5: Defining windows and rooflights – Windows & Rooflights tab).
- New sub-tab for "Storage & Secondary Circulation" in the Building Services form > HWS tab (see Section 7.6.3: Defining HWS – HWS tab).
- New parameter for insulation type on the hot water storage in the Building Services form > HWS tab > Storage & Secondary Circulation sub-tab (see Section 7.6.3: Defining HWS – HWS tab).
- New parameter for insulation thickness on the hot water storage in the Building Services form > HWS tab > Storage & Secondary Circulation sub-tab (see Section 7.6.3: Defining HWS – HWS tab).
- General sub-tab renamed to "Collector Parameters" sub-tab in the Building Services form > SES tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New input parameters for the solar collector performance parameters in the Building Services form > SES tab > Collector Parameters sub-tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).

- New sub-tab for “Solar Storage & Collector Loop” in the Building Services form > SES tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New parameter for solar hot water storage volume in the Building Services form > SES tab > Solar Storage & Collector Loop sub-tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New parameter for solar preheating type in the Building Services form > SES tab > Solar Storage & Collector Loop sub-tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New parameter for insulation type on the solar hot water storage in the Building Services form > SES tab > Solar Storage & Collector Loop sub-tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New parameter for insulation thickness on the solar hot water storage in the Building Services form > SES tab > Solar Storage & Collector Loop sub-tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New parameter for the heat transfer rate of the heat exchanger in the solar collector loop in the Building Services form > SES tab > Solar Storage & Collector Loop sub-tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New parameter for the overall heat loss coefficient of pipes in the solar collector loop in the Building Services form > SES tab > Solar Storage & Collector Loop sub-tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New sub-tab for “Auxiliary Energy & Distribution Losses” in the Building Services form > SES tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New parameter on the insulation of the distribution pipes between the solar energy system and the back up system in the Building Services form > SES tab > Auxiliary Energy & Distribution Losses sub-tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New parameter on the insulation of the distribution pipes between the solar energy system and the back up system in the Building Services form > SES tab > Auxiliary Energy & Distribution Losses sub-tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New parameter on the circulation system of the solar energy system in the Building Services form > SES tab > Auxiliary Energy & Distribution Losses sub-tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New parameter on the nominal pump power in the solar energy system in the Building Services form > SES tab > Auxiliary Energy & Distribution Losses sub-tab (see Section 7.6.4: Defining Solar Energy Systems (SES) – SES tab).
- New sub-tab for accessing supporting documents in the Ratings form (see Section 8.1.1: Building Regulations Check tab and 8.1.2: Asset Rating tab).
- Data reflection report of the actual building also produced in pdf format (see Section 8.2.3: Data Reflection Report – Actual Building).

Changes and additions in 26th May 2009 version 3.4.a:

1. Further explanation or clarification of **existing** parameters and functionality of iSBEM. *This **“Further guidance”** icon shown in the left margin is used to indicate these items in the text.*

    - Revised definition of the Reference building (see Section 2.3: Calculation basics for UK Energy Performance Certificate purposes).
    - Guidance on tips for gathering information for iSBEM (see Section 3.2: Tips for gathering information for iSBEM).
    - Guidance for users of Office 2007 (see Section 4.3: Opening iSBEM).
    - Guidance on sources of help information (see section 4.6: Getting assistance with using iSBEM).
    - Guidance on Activation Codes for Energy Assessors (see section 7.3.2: General Information tab).
    - Guidance on name of the Accreditation Scheme in the Energy Assessor details (see section 7.3.2: General Information tab).
    - Guidance on the rating with improvements field for Scottish EPCs in the General form > General Information tab > Project Details sub-tab (see Section 7.3.2: General Information tab and Section 8.2.7: Energy Performance Certificate).

- Guidance on zone height (see Section 7.5.3: Defining zones – Zones tab).
- Guidance on adjacency of envelopes (see Section 7.5.4: Defining envelopes – Envelope tab).
- Guidance on consequences of changing the HVAC system type (see Section 7.6.2: Defining HVAC Systems – HVAC Systems tab).
- Guidance on bivalent systems (see Section 7.6.2: Defining HVAC Systems – HVAC Systems tab).
- Guidance on default efficiency for heat generator for heating systems (see Section 7.6.2: Defining HVAC Systems – HVAC Systems tab).
- Guidance on default efficiency for heat generator for hot water systems (see Section 7.6.3: Defining HWS – HWS tab).
- Guidance on CHP (see section 7.6.7: Defining the CHP generator – CHP Generator tab).
- Guidance on default HVAC systems (see Section 7.6.8: Defining the zone specific building services- Zones tab).
- Guidance on lamp types (see Section 7.6.8: Defining the zone specific building services- Zones tab).
- Guidance on sub-dividing zones due to daylight (see Section 7.6.8: Defining the zone specific building services- Zones tab).
- Guidance regarding the building environment and main heating fuel for a building with no space or water heating (see Section 8.2.7: Energy Performance Certificate).

2. Changes related to **new functionality** of the iSBEM version **3.4.a**. *This **"new"** icon shown in the left margin indicates in the text where iSBEM has changed since the previous version.*

- Revised definition of the Reference building (see Section 2.3: Calculation basics for UK Energy Performance Certificate purposes).
- EPCs for unconditioned buildings (see Section 2.3: Calculation basics for UK Energy Performance Certificate purposes).
- Downloading and installing Patch01and Patch02 (see Section 4.2: Installing iSBEM on your computer).
- System configuration tab in the General form > File Options tab has been split into 2 tabs to accommodate new tick boxes (see Section 7.3.1: File Options tab).
- A new tick box in the General form > File Options tab > System Configuration (cont.) sub-tab to control the clearing of the contents of the Quick Envelopes tab (see Section 7.3.1: File Options tab and 7.5.8: Quick Envelopes tab: Short cut to creating envelopes and windows).
- A new tick box in the General form > File Options tab > System Configuration (cont.) sub-tab to switch between defining the glazing using areas or percentages in the Quick Envelopes tab (see Section 7.3.1: File Options tab and 7.5.8: Quick Envelopes tab: Short cut to creating envelopes and windows).
- A new sub-tab for Helpline Diagnosis (see Section 7.3.1: File Options tab).
- A new button to allow importing the Assessor Details from a previous version of iSBEM (see section 7.3.2: General Information tab).
- A new sub-tab for Air Conditioning Inspection data (see Section 7.6.1: Global and Defaults tab).
- New sub-tab for viewing Calculation Logs in the Ratings form (see Section 8.1.1: Building Regulations Check tab and 8.1.2: Asset Rating tab).
- New sub-tab for viewing Calculation Errors in the Ratings form (see Section 8.1.1: Building Regulations Check tab and 8.1.2: Asset Rating tab).
- New sub-tab for viewing received Messages in the Ratings form (see Section 8.1.2: Asset Rating tab).

This manual, together with the software tools described in it, were developed by the BRE for the Department for Communities and Local Government (CLG), under a contract managed for CLG by AECOM (formerly Faber Maunsell).

Disclaimer

The iSBEM User Guide cannot provide legal advice or a definitive interpretation of the law. The guidance provided in this document is limited to the technical operation of the software tool. It is offered in good faith but is not binding on any person(s) or organization. The same applies to the default values in the interface, which should be viewed as conservative suggestions intended to be replaced by actual values.

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Acronyms used in iSBEM and this guide

AHU	Air Handling Unit
BER	Building Emission Rate
BRUKL	Building Regulations United Kingdom Part L (The Building Regulations compliance checking module)
CEN	Comite Europeen de Normalisation (The European Committee for Standardisation)
CHP	Combined Heat and Power
CO_2	Carbon dioxide
ECA	Enhanced Capital Allowance
EER	Energy Efficiency Ratio
EPBD	Energy Performance of Buildings Directive
EPCgen	Energy Performance Certificate Generator (The EPC generator module)
ETL	Energy Technology List
HEPA	High Efficiency Particulate Air
HTHW	High Temperature Hot Water (boiler)
HVAC	Heating Ventilation and Air Conditioning
HWS	Hot Water System
IF	Improvement Factor
iSBEM	Interface for SBEM
LTHW	Low Temperature Hot Water (boiler)
LZC	Low or Zero Carbon
MTHW	Medium Temperature Hot Water (boiler)
NCM	National Calculation Methodology
PVS	Photovoltaic System
SBEM	Simplified Building Energy Model
SSEER	Seasonal System Energy Efficiency Ratio
SSEff	Seasonal System Efficiency
SES	Solar Energy System
SFP	Specific Fan Power
TER	Target Emission Rate
VAV	Variable Air Volume
VRF	Variable Refrigeration Flow

1. HOW TO USE THIS GUIDE

1.1. Scope of the guide

The purpose of this guide is to give an introduction to the use of iSBEM, an interface for SBEM (Simplified Building Energy Model) - an approach for the National Calculation Methodology (NCM) for assessing the energy performance of buildings.

This guide includes:

- An explanation of the role of iSBEM in the NCM with a brief overview of the methodology.
- How to set up iSBEM to operate on your computer.
- How to work through the steps of the input.
- How to obtain the Building Regulations compliance document ('Specification Information' for Scottish Building Regulations) and how to obtain an Energy Performance Certificate and Recommendations report.
- Guidance on how to assemble the required information for your own building.
- A tutorial.
- How to convert files created with previous versions of iSBEM version to be compatible with the new version (3.5.a).

This guide **does not** include:

- A detailed description of the structure of the NCM.
- A full definition of the notional building which is used to assess compliance with Building Regulations and produce the rating required by the Energy Performance of Buildings Directive (EPBD), or the reference and typical buildings.
- A description of the contents of the NCM Construction, Glazing, or Activity area databases.

  The above can be found in **The NCM Manual** which is available on CLG's website.
- A detailed description of SBEM, the calculation engine to which iSBEM is an interface. This is described in the SBEM Technical Manual, available for download from the NCM website at www.ncm.bre.co.uk.
- Guidance related to energy calculations for the Republic of Ireland Building Regulations.

1.2. Structure of the guide

This guide is split into eight chapters and five appendices, and it contains a tutorial.

TUTORIAL: The tutorial runs alongside Chapters 4 through to 8 with a task set at each stage, starting from opening iSBEM through to printing off the Compliance document and Energy Performance Certificate. It is recommended that you complete this tutorial before trying to enter real building data. Details on the Example building used in the tutorial are included in APPENDIX A:.

Chapter 1: HOW TO USE THIS GUIDE

Chapter 2: INTRODUCTION TO iSBEM, SBEM, AND THE NCM

Chapter 3: ASSEMBLING REAL BUILDING DATA

This chapter provides guidance on preparing building data for inputting into iSBEM, including how to zone a building.

TUTORIAL

Chapter 4: iSBEM BASICS – GETTING STARTED

This chapter includes instructions on how to install iSBEM, start a new or open an existing project, and correctly save and close projects.

Chapter 5: TOUR OF iSBEM

This chapter introduces the structure of iSBEM in terms of its *forms*, *tabs*, and *sub-tabs*.

Chapter 6: BASIC iSBEM FUNCTIONALITY AND THE HELP MENU

This chapter details some of iSBEM's key commands, buttons, and functionality.

Chapter 7: ENTERING A BUILDING INTO iSBEM

This chapter takes the user through each of the forms in turn and explains the steps of inputting a building into iSBEM.

Chapter 8: CALCULATING AND VIEWING THE ENERGY PERFORMANCE OF THE BUILDING- THE RATINGS FORM AND OUTPUT REPORTS

This chapter explains how to produce the Compliance document for Building Regulations, obtain the Asset Rating, and view the other output documents produced by SBEM.

APPENDIX A: Tutorial building details and iSBEM

APPENDIX B: iSBEM file conversion.

APPENDIX C: User-defined construction database.

APPENDIX D: List of parameters required by iSBEM.

APPENDIX E: Activation codes and connection to EPCgen.net.

APPENDIX F: Matrix of activity areas and building types.

NEW **APPENDIX G:** Agreed convention for decision on assessment level.

NEW **APPENDIX H:** Agreed convention for determining dimensions.

2. INTRODUCTION TO iSBEM, SBEM, AND THE NCM

2.1. What is iSBEM, SBEM, and the NCM?

The Energy Performance of Buildings Directive (EPBD) 2002/91/EC of the European Parliament and Council (dated 16th December 2002) requires that the energy performance of new buildings be evaluated with a calculation methodology that complies with the Directive. Separately, the Directive calls for the production of energy performance certificates for many existing buildings. This uses the same calculation methodology, although this is not mandatory. In response, the UK Department for Communities and Local Government (CLG) has commissioned the National Calculation Methodology (NCM) for the energy performance of buildings.

The initial use of the NCM was for compliance with the 2006 amendments to Part L of the Building Regulations in England and Wales. The NCM is required for compliance with Advisory Documents ADL1A and ADL2A, but not for situations covered by ADL1B or ADL2B. Similar amendments have been made in Scotland and Northern Ireland (Scottish Building Regulations Section 6 and Northern Ireland Building Regulations Part F).

For dwellings, the NCM consists of a new version of the existing Standard Assessment Procedure (SAP). This is not dealt with in this Guide.

SBEM, iSBEM, and the associated databases and files are an implementation of the non-domestic building part of the NCM that is freely available to users (subject to certain licence conditions). Other accredited software may be used if preferred, but it is intended that SBEM and iSBEM should be applicable to the majority of buildings.

The initial versions of SBEM and iSBEM have principally been aimed at meeting Building Regulations requirements. In later versions, further features have been incorporated in order to allow them to be used to generate Energy Performance Ratings for existing non-domestic buildings.

This manual describes how to use iSBEM to check for compliance with the 2006 Building Regulations and to generate an Energy Performance Certificate for countries throughout the UK.

The approach to the NCM embodied in this tool comprises a calculation engine called the Simplified Building Energy Model (SBEM[i]) operating with a user interface called iSBEM[ii]. The purpose of SBEM and its interface is to produce consistent and reliable evaluations of energy use in non-domestic buildings for Building Regulations Compliance (and for building performance certification purposes.) Although it may assist the design process, it is not primarily a design tool and should not be used for making strategic design decisions. It does not calculate internal temperatures, for example.

It is anticipated that vendors of design and other software will offer design and asset rating calculations as part of their packages, either by embedding SBEM within them or by offering accredited alternative calculation methods.

SBEM consists of a calculation methodology (described below), which runs together with a compliance checking module (BRUKL) and an energy performance certificate generator (EPCgen) which utilise some of the same data during the calculation. The user sees iSBEM, the interface software, which interweaves these components together and interacts with a series of databases to provide consistent data to the calculation while simplifying the user's need to obtain raw building construction data.

[i] Pronounced s-bem.
[ii] Pronounced i-s-bem.

SBEM is a compliance procedure and not a design tool. If the performance of a particular feature is critical to the design, even if it can be represented in SBEM, it is prudent to use the most appropriate modelling tool for design purposes. In any case, SBEM should not be used for system sizing.

2.2. Calculation basics for UK Building Regulations compliance purposes

The calculation procedure required by the NCM is explained more fully in the National Calculation Methodology Manual. SBEM complies with the NCM. It is suitable for use with the majority of buildings, but some designs will contain features that mean that more accurate energy calculations may be obtained by more sophisticated calculation methods.

In summary, the Building Regulations compliance calculation compares the total energy consumption of the building and its services (in kWh/m^2.annum), expressed as carbon dioxide emissions of the building being evaluated (its "Building Emission Rate" or BER) with a target value ("Target Emission Rate" or TER) derived from similar calculations for a "notional building" (where both emission values are in kgCO_2/m^2. annum).

The notional building has the following characteristics:

- The same geometry, orientation, and usage as the evaluated building.
- The amount of glazing in the notional building is, however, not the same as that in the evaluated building. The area of glazing is a fixed percentage of every external wall and roof and is dependent on the building type.
- It is exposed to the same weather conditions as the evaluated building.
- Standard operating patterns (to allow consistent comparison between buildings in the same sector).
- Standardised assumptions for building fabric, glazing, and HVAC plant efficiencies (Generally, but not always, these comply with the 2002 Building Regulations).

NB: According to ADL2A, if the actual building has a supply of natural gas, the heating and hot water fuel for the notional building is natural gas. If there is no natural gas used anywhere in the actual building, the heating and hot water fuel is oil in the notional building. In addition, according to the NCM Modelling Guide, when the "main heating fuel" in the actual building is a low or zero carbon (LZC) heating technology, then natural gas must be used in the notional building. For the purposes of the guide, the main heating fuel should be taken as the fuel which delivers the greatest total thermal output (space or water heating) over the year, and the low or zero carbon (LZC) heating technologies to include: biomass, biogas, heat pumps, and waste heat. The notional building will always use grid-supplied electricity as fuel for cooling and auxiliary energy.

Any service not covered by the Building Regulations (e.g., emergency escape lighting, specialist process lighting, etc.) is ignored in both the actual and notional buildings.

The "Target Emissions Rate" (TER) for the current (2006) Building Regulations requires an improvement factor to be applied to the notional building's performance, together with a factor to encourage the application of low and zero carbon technologies. The following equation and table of factors are extracted from the Approved Document L2A: Conservation of Fuel and Power in New Buildings Other than Dwellings.

TER = $C_{notional}$ x (1 – improvement factor) x (1 – LZC benchmark)

Where:

"**$C_{notional}$**" is the CO_2 emissions rate from the notional building.

"**Improvement factor**" is the required improvement in energy efficiency (expressed as CO_2 emissions) as given in column (a) of Table 1 appropriate to the classes of building services in the proposed building. If different areas of the proposed building have different classes of building services, then the level of improvement should be calculated by applying the relevant improvement factor to each separate activity area individually.
"**LZC benchmark**" is the benchmark provision for low and zero carbon (LZC) energy sources as given in column (b) of Table 1.

Building services strategy	(a) Improvement factor	(b) LZC benchmark
Heated and naturally ventilated (and spaces with no heating or ventilation)	0.15	0.10
Heated and mechanically ventilated	0.20	0.10
Air-conditioned	0.20	0.10

Table 1: Improvement factors and LZC benchmarks for use in the TER equation (Approved Document L2A: Conservation of Fuel and Power in New Buildings Other than Dwellings)

For example, the TER for an air-conditioned space would be: $C_{notional}$ x (1 – 0.20) x (1 – 0.10) = 0.72 x $C_{notional}$; i.e., an improvement of 28% over the emission rate of the notional building.

Potentially, these improvement factors could be increased as future changes to the Building Regulations demand higher standards. The compliance check is then based on the relative performance of the BER and TER. (A similar method is used for the Building Regulations in Scotland and Northern Ireland.)

SBEM calculates the energy demands of each space in the building according to the activity within it. Different activities may have different temperatures, operating periods, lighting standards, etc. SBEM calculates heating and cooling energy demands by carrying out an energy balance based on monthly average weather conditions. This is combined with information about system efficiencies in order to determine the energy consumption. The energy used for lighting and hot water is also calculated. This requires information from the following sources:

Information	Source
Building geometry such as areas, orientation, etc.	Assessor reads from drawings or direct measurement.
Weather data	Internal database.
Selection of occupancy profiles for activity areas	For consistency, these come from an internal Activity database – assessor selects by choosing building type and activity from database for each zone.
Activity assigned to each space	Assessor defines within iSBEM by selecting from internal database (the user should identify suitable zones for the analysis by examining the building or drawings).
Building envelope constructions	Assessor selects from internal Construction and Glazing databases or inputs parameters directly ("Inference" procedures may be used for energy certification of existing buildings). Assessor can also define their own

	constructions in the user-defined construction database.
HVAC systems	Assessor selects from internal databases or inputs parameters directly
Lighting	Assessor selects from internal databases or inputs parameters directly

Table 2: Calculation parameters for SBEM

The "inference" facility in iSBEM guides the assessor through the data input procedures and directs him/her towards appropriate internal databases. This option is intended for use when certifying existing buildings if the drawings or construction information are not available.

Further information can be found in the Building Regulations 2006 Approved Document Part L, which can be accessed from http://www.planningportal.gov.uk/uploads/br/BR_PDF_ADL2A_2006.pdf and the Non-Domestic Heating, Cooling, and Ventilation Compliance Guide, which can be accessed from http://www.planningportal.gov.uk/uploads/br/BR_PDF_PTL_NONDOMHEAT.pdf.

Also, Scottish Building Regulations Section 6 can be accessed from http://www.sbsa.gov.uk/tech_handbooks/th_pdf_2007/Section_6_Non-domestic_20072.pdf.

For Northern Ireland, please refer to www.epb.dfpni.gov.uk for further information on building regulations.

2.3. Calculation basics for UK Energy Performance Certificate purposes

This section defines the "reference" and "typical" buildings, which are the basis of setting the energy rating scale for Energy Performance Certificates (EPCs) for England and Wales. The "Asset Rating" rates the CO_2 emissions from the actual building in comparison to a Standard Emission Rate (SER), where both emission values are in $kgCO_2/m^2$. annum. The Standard Emission Rate is determined by applying a fixed improvement factor to the emissions from a reference building, which is defined below.

EPCs are intended to send market signals about the relative performance of comparable buildings, and so it is necessary that the reference building should be the same for all buildings of a given type. In order to provide this consistency, the reference building must be the same irrespective of: (a) whether the building is naturally ventilated or air conditioned and (b) the fuel choice.

The insulation levels and HVAC efficiencies in the reference building are identical to the Part L notional building except that certain parameters in the reference building are fixed (subject to conditions below) irrespective of features in the actual building. These aspects are:

a. The heating and hot water service is always met by a gas-fired system irrespective of whether a fuel other than gas is used in the actual building, or is even available in the locality of the actual building.

b. The spaces in the Reference building have a fixed servicing strategy regardless of the strategy adopted in the actual building (except if the corresponding space in the actual building is unconditioned – see below). Therefore:

    - Each space is heated to the heating setpoints defined in the activity database, irrespective of whether the particular space in the actual building

has heating provision or not (except if the corresponding space in the actual building is unconditioned – see below).

- Each space is cooled, to a fixed cooling setpoint, irrespective of whether the particular space in the actual building has cooling provision or not (except if the corresponding space in the actual building is unconditioned – see below).
- Each space which is unconditioned in the actual building will also be unconditioned in the reference building (i.e., unheated and uncooled).
- Each space is naturally ventilated, irrespective of whether the corresponding space in the actual building has natural or mechanical ventilation.

Further guidance

The CO_2 emissions arising from the use of the fixed building services in the reference building (in $kgCO_2/m^2$. annum) are calculated (the Reference Emission rate or RER), and then adjusted by an improvement factor 23.5%. This adjusted CO_2 emission rate (in $kgCO_2/m^2$. annum) is termed the Standard Emission Rate (SER), i.e., SER = RER*0.765.

It is not intended that the definition of the reference building should change as Part L standards change, since this would mean that the energy rating of a given building would also change, even if its energy efficiency had not been varied. Therefore, the reference building is always as defined above.

The Asset Rating (AR) is simply the ratio of the CO_2 emissions from the actual building (i.e., the BER) to the Standard Emission Rate (i.e., the SER) multiplied by 50. The AR should be rounded to the nearest whole number. It is also converted into an energy band/grade on a linear "A-G" scale, where the border between grade B and grade C is set at the SER and given an AR of 50. This means that a gas-heated mixed-mode building that is just compliant with Part L (2006) would have an Asset Rating of 50.

$$\frac{BER}{SER} * 50 = AR$$

In addition to the Asset Rating, it has been decided that the EPC should display two additional calculated items as references/benchmarks:

a. The building regulations standard (i.e. the TER). Note this is based on the performance of the notional building, not the reference building.

b. The performance of a "typical building", which is based on the 1995 Building Regulations Part L standards, and its CO_2 emissions rate is termed the Typical Emission Rate (TYR).

More details on the calculation procedure required by the NCM and the definition of the rating scale are explained fully in the National Calculation Methodology Modelling Guide.

Further information on EPCs can be found in CLG's publication: "Improving the energy efficiency of our buildings: A guide to energy performance certificates for the construction, sale and let of non-dwellings" which can be accessed from www.communities.gov.uk/publications/planningandbuilding/nondwelling. This document provides an introduction to energy performance certificates for non-dwellings, describes the scope and requirements of the Regulations that apply on construction, sale or let, and provides guidance on how these are applied in practice.

For information on the approved accreditation schemes, please refer to: http://www.communities.gov.uk/planningandbuilding/theenvironment/energyperformance/energyassessorqualification/accreditationstatement/.

In Scotland, the EPC displays the approximate CO_2 emissions and energy usage of the building based on a standardised use of the building. The Rating is expressed as the CO_2 emissions in kg per m^2 of floor area per year, and it determines where the building sits on

a seven band scale. The EPC also includes a list of recommendations for the cost-effective improvements (lower cost measures) of the energy performance. Further information can be found in the Scottish Building Regulations Section 6, which can be accessed from http://www.sbsa.gov.uk/tech_handbooks/th_pdf_2007/Section_6_Non-domestic_20072.pdf.

For Northern Ireland, the EPC is very similar to that in England and Wales. Please refer to www.epb.dfpni.gov.uk for further information on building regulations.

NB: Communal areas that accompany units with independent heating systems when using iSBEM to produce an EPC: Please refer to CLG's website at: http://www.communities.gov.uk/planningandbuilding/theenvironment/energyperformance/energyperformancefaqs/epccommercialfaqs#named7, which advises the following:

In the guidance (*Improving the Energy Efficiency of our Buildings - A Guide to Energy Performance Certificates for the Construction, Sale and Let of Non-Dwellings* - section 4.2.2 scenario B1 – a centre with conditioned central space and independent heating systems) - note was made of including a proportion of the energy consumption of the conditioned central space in the EPC for a unit. The following advice should replace 4.2.2 scenario B1 in the guidance: In practice, where a centre has units and a common space all with independent heating systems, one EPC can be provided by a seller or landlord for the whole building only if it is being sold or let as a whole. Otherwise, a seller or landlord should provide an EPC for the part (or unit) being sold or let plus an EPC for the common space. The prospective buyer or tenant can then make their decision on the basis of the energy rating for the unit and the energy rating for the common space that serves the unit.

NB: While no EPCs are required for permanently unconditioned buildings (i.e., buildings which do not use energy to condition the indoor climate and are expected to remain this way), it will be possible to voluntarily lodge EPCs for unconditioned buildings and, as such, the definition of the Reference building has been revised (see above) in order to allow for the calculated energy rating for these types of buildings to be representative. Permanently unconditioned buildings are different to those which are expected to be conditioned later on, and which should be modelled as per the guidance in CLG's publication: "Improving the energy efficiency of our buildings: A guide to energy performance certificates for the construction, sale and let of non-dwellings" which can be accessed from www.communities.gov.uk/publications/planningandbuilding/nondwelling.

2.4. Calculations for the Republic of Ireland Building Regulations purposes

SBEM is now able to accommodate the calculations for the Republic of Ireland Building Regulations. However, the basics of the calculation and guidance on the related input parameters are dealt with in a separate version of this User Guide specifically for the Republic of Ireland.

2.5. Deciding whether SBEM is appropriate

All calculation processes involve some approximations and compromises, and SBEM is no exception. The most obvious limitations relate to the use of the CEN monthly heat balance method. This means that processes which vary non-linearly at shorter time-steps have to be approximated or represented by monthly parameters. The HVAC system efficiencies are an example of this. On the other hand, SBEM does have provision to account for processes that may not be present in software packages that contain more

sophisticated fabric heat flow algorithms, such as, duct leakage, thermal bridge calculations, and infiltration allowances.

The user interface, iSBEM, provides the user with routes by which some non-standard systems and other features can be represented. For example, the ability to input specific fan powers provides a route by which demand-controlled ventilation might be handled, using pre-calculated effective SFP. There are also possibilities to go beyond these within the existing SBEM model via more general interfaces. For example, other countries have implemented night ventilation procedures with monthly heat balance calculation engines.

It is, therefore, difficult to give absolute rules about when SBEM can and cannot be used. As broad guidance, it is more likely to be difficult to use SBEM satisfactorily if the building and its systems have features that are (a) not already included in iSBEM and (b) have properties that vary non-linearly over periods of the order of an hour. However, as the example above shows, this is not a universal rule. There is a balance between the time and effort required to carry out parametric studies to establish input values for SBEM and detailed explicit modelling of a particular building.

Features which cannot currently be represented in iSBEM:

- Night ventilation strategy
- Ventilation with enhanced thermal coupling to structure
- Demand-controlled ventilation
- Automatic blind control
- Light transfer within a building, for e.g., through highly glazed internal surfaces between atria and surrounding spaces.

If in doubt about whether iSBEM would be appropriate for modelling your building, please contact your Accreditation Scheme Provider.

2.6. Overview of how a building is defined in iSBEM

There is a number of stages to inputting a building in iSBEM:

a Enter general information about the building, the owner, and the certifier/assessor ('agent' for Scottish Building Regulations), and select the appropriate weather data.

b Build up a database of the different forms of constructions and glazing types.

c After "zoning" the building (on the drawings), create the zones in the interface, and enter their basic dimensions, along with the air permeability of the space.

d Define the envelopes of each zone, i.e., walls, floor, ceiling, etc. The envelopes' areas, orientations, the conditions of the adjacent spaces, and the constructions used all need to be defined.

e Within each envelope element, there may be windows/rooflights or doors. The areas and types of glazing or door within each envelope element need to be entered.

f Similarly, within the envelope elements or within the window/door, there may be additional thermal bridges which need to be defined.

g Define the HVAC (heating, ventilation, and air conditioning) systems, the HWSs (hot water systems), and any SES (solar energy systems), PVS (photovoltaic systems), wind generators, or CHP (combined heat and power) generators used in the building.

h Define the lighting system and ventilation characteristics of each zone, and assign the zones to the appropriate HVAC system and HWS.

i Run the calculation and assess compliance.

The building services systems, zones, envelope elements, windows, and doors are all referred to as "**building objects**" in SBEM. Figure 1 shows each of these building objects and demonstrates how they are linked together so that SBEM can calculate the energy consumption of the building. This diagram gives you an overview of what information is required and where you have to enter it in iSBEM. It may be useful to return to this figure at the end of the tutorial, by which point you will have been introduced to all the building objects.

Figure 1 serves to provide an overview of the structure of the building objects that you will be introduced to in this User Guide. More details on each item and how they are defined and linked together will be provided in detail in Chapters 5 to 8 and through the *Help* menu accessible from within iSBEM.

Building object	Key parameters needed to define this building object	Object(s) to which it needs to be linked	Where it is defined in iSBEM
Zone	Dimensions, activity type, details on lighting, heating, and ventilation strategy.	HVAC and HWS	Geometry form > Zones tab and in the Building Services form > Zones tab
Envelope Elements	Type of envelope (wall/floor/roof), area, orientation, construction type, thermal bridges, condition of adjoining space.	Zone	Geometry form > Envelopes tab or the Geometry form > Zones tab > Quick-Envelopes sub-tab
Windows	Dimensions, glazing type, thermal bridges, shading system, transmission factor, and whether it is a display window or not.	Envelope Element	Geometry form > Windows & Rooflights tab or the Geometry Form > Zones tab > Quick Envelopes sub-tab
Doors	Area, construction type, thermal bridges, and type of door.	Envelope Element	Geometry form > Doors tab
HVAC	System type, heat source, fuel type, further details on efficiencies, duct leakage, specific fan power, and controls.	Zone	Building Services form > HVAC systems tab
HWS	Generator type, fuel type, details on efficiency and whether it is a storage system.	Zone	Building Services form > HWS tab
SES	Dimensions, orientation, inclination.	HWS	Building Services form > SES tab
PVS	Dimensions, orientation, inclination and type.	-	Building Services form > PVS tab
Wind generator	Terrain type, dimensions, and power.	-	Building Services form > Wind generator
CHP generator	Fuel type, details on efficiency, building heat and hot water supplied, and thermal and electrical efficiencies.	(HVAC)	Building Services form > CHP tab

Hierarchy of SBEM building objects

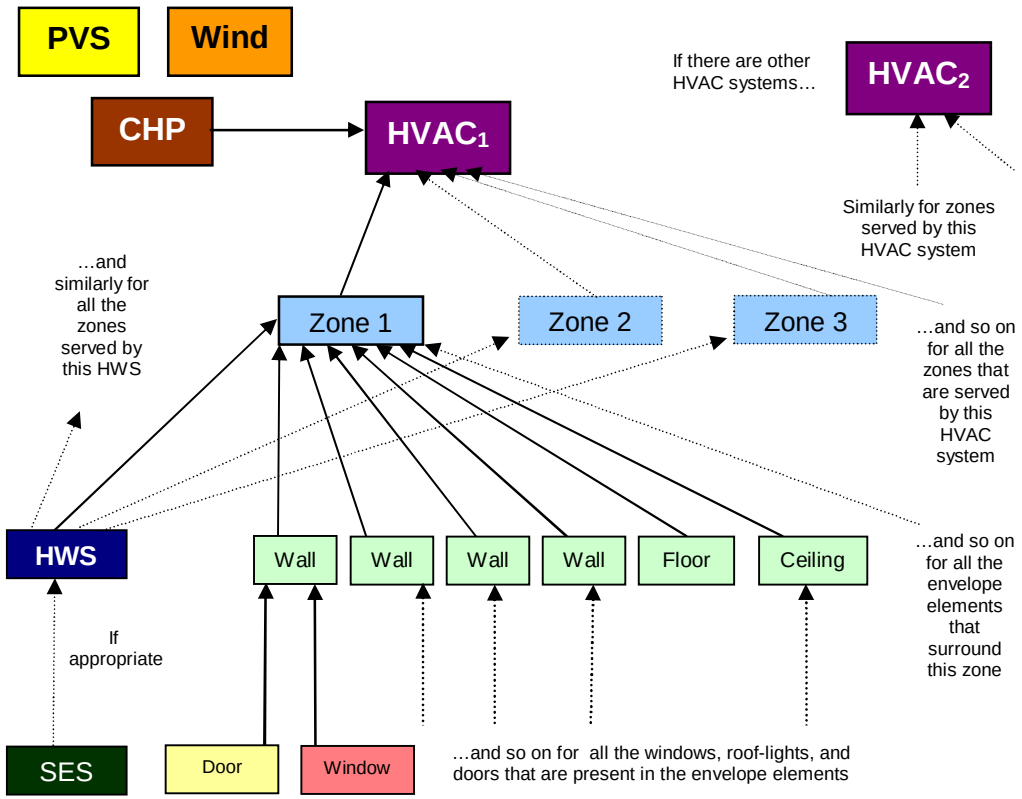


Figure 1: Structure of SBEM objects

3. ASSEMBLING REAL BUILDING DATA

3.1. Introduction

There are four steps to calculating the ratings for a building. First, a decision needs to be made on whether SBEM is the appropriate analysis tool. Then, information on the building needs to be gathered, analysed, and finally, entered into the interface. The tutorial in this Guide focuses on the functionality of the tool. To ease that process, all the information on the Example building is provided, and the zoning is done for you. However, when analysing a real building you will need to collect and analyse the building data yourself. This chapter will guide you on what information you need to gather, and how you need to process this information before you can enter it into the interface, iSBEM.

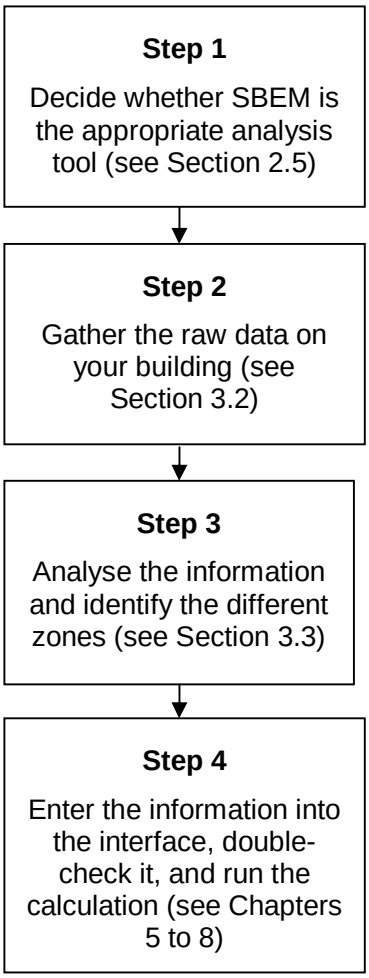

Step 1
Decide whether SBEM is the appropriate analysis tool (see Section 2.5)
Step 2
Gather the raw data on your building (see Section 3.2)
Step 3
Analyse the information and identify the different zones (see Section 3.3)
Step 4
Enter the information into the interface, double-check it, and run the calculation (see Chapters 5 to 8)

Figure 2: Steps for calculating the rating for a building

3.2. Tips for gathering information for iSBEM

Item	Requirements	Potential issues and experiences	
		New build and refurbishment	**Existing building**
Architectural: building spatial layout of functions, geometry, and orientations	Building plans, sections, site plan	Plans and schedules should be available at this stage. What degree of detail do they show? For instance, have decisions been made on usage of each space in the building?	Are plans available? Have they been kept up to date? Can they be used? What degree of detail do the plans show? Have there been changes to the internal layout (with consequent effects on activity type, area, and geometry)? Don't assume that adequate information on an existing building can be obtained easily. Any planning should include time to physically survey at least some parts of the building. Note that there may be practical obstacles to overcome, such as gaining access to secure parts of the building such as plantrooms or areas where confidential work takes place. This may need to be resolved with the building owner and occupier prior to the visit. There could also be safety issues to consider, such as access to the roof or looking into ceiling voids.
Envelope construction materials; air permeability	Detailed drawings, schedules of construction details; pressure test result	Detailed drawings and schedules should be available. What degree of detail do they show? For instance, do details show junctions and hence thermal bridges? Do they rely on the constructors to use initiative to select suitable materials? Has there been confirmation that as-built constructions are equivalent to or better than as-designed?	Are drawings and schedules available? How up-to-date are they? What degree of detail do they show? Have there been changes, for instance replacement windows, re-roofing, or additional insulation? Any direct investigation of construction details such as wall or roof constructions and thermal bridges by opening them up should only be undertaken with the written approval of the building owner and consent of occupants. If this is not given (it would be unusual), then it is possible, using databases built into the software, to infer construction details from non-invasive observations and construction date (assuming compliance with the then current Building Regulations). Any assumptions made must err on the pessimistic side (i.e. constructions that are older and/or do not contain cavities unless their presence can be

			inferred from the external appearance) .
Building Services	Description of plant and its control, schedules of plant sizing including fans, information on construction standards (e.g. leakage tests on ductwork), confirmation that M&T is being undertaken	Detailed drawings and schedules should be available. What degree of detail do they show? For instance, is it possible to work out specific fan power from fan power and air quantity? Has the fine detail of installation been left to equipment suppliers and installers – If so, could they inadvertently compromise the design intent? Are any test certificates available? Is there sub-metering for HVAC systems and/or lighting, and if monitoring and targeting are to be practiced, are out of range alarms built into the software or procedures? Is lighting design information available, rather than relying on simple lamp type information?	Are drawings and schedules available? Are they held on site or by a maintenance or other remote contractor? Is there a building log book? How up-to-date are they? What degree of detail do they show? Have there been changes, such as plant replacement or to the control philosophy? Are there any results of tests on the equipment as installed – seasonal system efficiencies, leakage tests on ductwork and/or air handling plant, confirmation of air volumes, etc? You may be able to confirm with the energy manager whether there is sub-metering for HVAC systems and/or lighting, and if monitoring and targeting are practiced, that out of range alarms are built into the software or procedures. It would also be useful to confirm with the facilities manager which lamp types are used in each zone, and which zones have which types of lighting control applied. If written information is not available, the plant will need to be surveyed. Who has access to plant rooms and when? There are safety issues. Is the surveyor familiar with plant type and specifications? It can be difficult to identify systems from simple visual inspection. Default efficiencies will depend on the installation date and/or ECA listing of equipment – can this be verified from purchase documentation? Any assumptions made must err towards a less efficient plant and/or less precise control. If an external contractor has responsibility for operation or maintenance, it may be necessary to probe carefully how the plant is actually configured. This is to avoid misunderstandings on how it should work.

Table 3: Tips for gathering information for iSBEM

Further guidance

Convention: Convention for EPCs - Use of default values

The conventions group has ruled that the energy assessor shall only use the default values within the Software Tool in the absence of any conventions identified within the conventions documents[iii] or through more specific information on the building. Where a default value is selected, the assessor must provide evidence in the *Ratings* form > *Asset Rating* tab > *EPC audit* sub-tab detailing why the default value has been selected. This is to enable their Accreditation Scheme Provider to verify the appropriate use of default values during Quality Assurance processes.

Use of default values should be avoided where possible.

3.3. Zoning guide – How to zone your building

The way a building is subdivided into zones will influence the predictions of energy performance. Therefore, the NCM Modelling Guide defines zoning rules that must be applied when assessing a building for Building Regulations purposes (compliance or energy certification). The end result of the zoning process should be a set of zones which are distinguished from all others in contact with it by differences in one or more of the following:

- The Activity attached to it
- The HVAC system which serves it
- The lighting system within it
- The access to daylight (through windows or rooflights).

To this end, the suggested zoning process within a given floor plate is as follows:

1. Divide the floor into separate physical areas, bounded by physical boundaries, such as structural walls or other permanent elements.
2. If any part of an area is served by a significantly different HVAC or lighting system, create a separate area bounded by the extent of those services.
3. If any part of an area has a different activity taking place in it, create a separate area for each activity.
4. Attribute just one *Activity* (selected from the drop-down list available for each building type) to each resulting area. If the building is speculative, and the activity is not fully defined, select the appropriate 'Speculative Activity' for the relevant building type.
5. Divide each resulting area into *Zones* receiving significantly different amounts of daylight, defined by boundaries which are:
    - At a distance of 6m from an external wall containing at least 20% glazing.
    - At a distance of 1.5 room heights beyond the edge of an array of rooflights if the area of the rooflights is at least 10% of the floor area.
    - If any resulting *Zone* is less than 3m wide, absorb it within surrounding zones.
    - If any resulting *Zones* overlap, use your discretion to allocate the overlap to one or more of the *Zones*.

NB: Currently iSBEM is not able to realistically model sunspaces or atria, as it cannot represent light transfer between highly glazed/reflective internal spaces such as these. For buildings where these elements are a significant part of the design, we suggest that the building be modelled

[iii] Contact your Accreditation Scheme Provider for a copy of the Commercial EPCs Conventions document.

using approved dynamic simulation models (http://www.ukreg-accreditation.org/) but only if they do allow internal light transfer to be modelled.

Further guidance

Convention: Convention for EPCs - Passive daylight features

The conventions group has decided that buildings with the following may be assessed using SBEM, as long as other features that cannot be modelled by SBEM are not present:

- Light wells open to the sky can be treated as courtyards (i.e., for consistency, they are approximated as exterior spaces with ordinary daylight access).

- Sun/light pipes should be ignored for the purposes of zoning and the daylight contribution they make.

6. Merge any contiguous areas which are served by the same HVAC and lighting systems, have the same *Activity* within them (e.g., adjacent hotel rooms, cellular offices, etc.), and which have similar access to daylight, unless there is a good reason not to.

NB: Small unconditioned spaces like store cupboards, riser ducts, etc., can be absorbed into the adjacent conditioned spaces. In iSBEM, this would involve adding their floor area to that of the adjacent conditioned space. Larger areas should be treated as indirectly conditioned spaces. See note in Section 7.6.8: Defining the zone specific building services, regarding indirectly conditioned spaces.

7. Each *Zone* should then have its envelopes described by the area and properties of each physical boundary. Where a *Zone* boundary is virtual, e.g., between a daylit perimeter and a core *Zone*, no envelope element should be defined. SBEM will then assume no transfer of heat, coolth, or light across the boundary, in either direction. In the context of iSBEM, the building needs to be divided into separate *Zones* for each *Activity* area, subdivided where more than one HVAC system serves an *Activity* area.

NB: If the internal envelopes between merged zones have been designed of heavy construction to have thermal mass, then their κ_m value (renamed from C_m value) will determine how the building retains and emits heat, and hence they should be defined in iSBEM. You can sum the areas of two or more internal walls (between merged zones) with the same construction and orientation and enter them as one envelope (assigned to the zone resulting from the merging) whose adjacency is “Same space”. If, on the other hand, the internal walls are partitions of light construction and very small thermal mass, then they should not cause any significant effects on the calculation if they were omitted from the iSBEM model. If in doubt about the thermal mass of the internal partitions, it is better to err on the side of caution and include them in your model as described above.

NEW

Further guidance

NB: The term “zone” is used as a short hand for “activity area” throughout this manual. It should not be assumed to be the same as a building services control zone, for instance, on the basis of building façade, although in some cases they may align.

NB: For building regulations calculations purposes, we recommend that users generally avoid creating more than 100-150 zones in iSBEM. However, the processing time will depend on the total number of objects (not just zones), i.e., zones, envelopes, windows, etc. Note that for building regulations compliance checking, the calculation has to generate 2 buildings: the actual and notional, so the number of objects (all the zones, envelopes, windows, etc.) that the calculation has to process is multiplied by 2, while for the asset rating to be calculated for an EPC, 4 buildings need to be generated: actual, notional, typical, and reference, i.e., all the objects in the input are multiplied by 4 to give the total number of objects being processed by SBEM. Hence, creating a project with a very large number of objects will slow down the calculation and may cause it to crash.

3.4. Measurement and other conventions

In order to provide consistency of application, standard measurement conventions have been adopted to be used as part of the NCM. These apply to both accredited dynamic simulation tools and third party software interfaces to SBEM, although some parameters may only relate to the latter. These conventions are specified in Table 4 below:

Parameter	Definition
Zone Height	Floor to floor height (floor to soffit for top floor), i.e., including floor void, ceiling void, and floor slab. Used for calculating length of wall-to-wall junctions, radiant and temperature gradient corrections, and air flow through the external envelopes due to the stack effect.
Further guidance	**Convention:** Convention for EPCs - Dimension conventions For further guidance on defining zone height in a range of building configurations, see APPENDIX H:
Zone Area	Floor area of zone calculated using the internal horizontal dimensions between the internal surfaces of the external zone walls and half-way through the thickness of the internal zone walls (see Figure 3). Used to multiply area-related parameters in databases. Area basis needs to be consistent with that for operational ratings. NB: If the zone has any virtual boundaries, the area of the zone is that delimited by the 'line' created by that virtual boundary.
Further guidance	**Convention:** Convention for EPCs - Dimension conventions For further guidance on defining horizontal dimensions in a range of building configurations, see APPENDIX H:
(Building) Total Floor Area	Sum of zone areas. Used to check that all zones have been entered.
Envelope Area	Area of vertical envelopes (walls) = h * w, where: h=floor to floor height (floor to soffit on top floor), i.e., including floor void, ceiling void, and floor slab w=horizontal dimension of wall. Limits for that horizontal dimension are defined by type of adjacent walls. If the adjacent wall is external or a perimeter wall, the limit will be the internal side of the adjacent wall. If the adjacent wall is internal, the limit will be half-way through its thickness. NB: Areas of floor, ceilings, and flat roofs are calculated in the same manner as the zone area. Area for an exposed pitched roof (i.e., without an internal horizontal ceiling) will be the inner surface area of the roof. Used to calculate fabric heat loss, so this is the area to which the U-value is applied.
Further guidance	

Further guidance

	Convention: Convention for EPCs - Dimension conventions For further guidance on defining envelope areas in a range of building configurations, see APPENDIX H:
Window Area	Area of the structural opening in the wall/roof, i.e., it includes the glass and the frame.
Deadleg Length	Length of the draw-off pipe to the outlet in the space (only used for zones where the water is drawn off). Used to determine the additional volume of water to be heated because the cold water in the deadleg has to be drawn off before hot water is obtained. Assumes that HWS circulation maintains hot water up to the boundary of the zone, or that the pipe runs from circulation or storage vessel within the zone.
Flat Roof	Roof with a pitch of 10 degrees or less.
Pitched Roof	Roof with a pitch greater than 10 degrees and less than or equal to 70 degrees. If the pitch is greater than 70 degrees, the envelope should be considered a wall.
Display Window	As defined in ADL2A.
Personnel Door	As defined in ADL2A.
High Usage Entrance Door	As defined in ADL2A.
Vehicle Access Door	As defined in ADL2A.
Glazed door	When doors have more than 50% glazing, then the light/solar gain characteristics must be included in the calculation. This is achieved by defining these doors as windows. (Otherwise, they are defined as opaque doors.)

Table 4: Measurement and other conventions

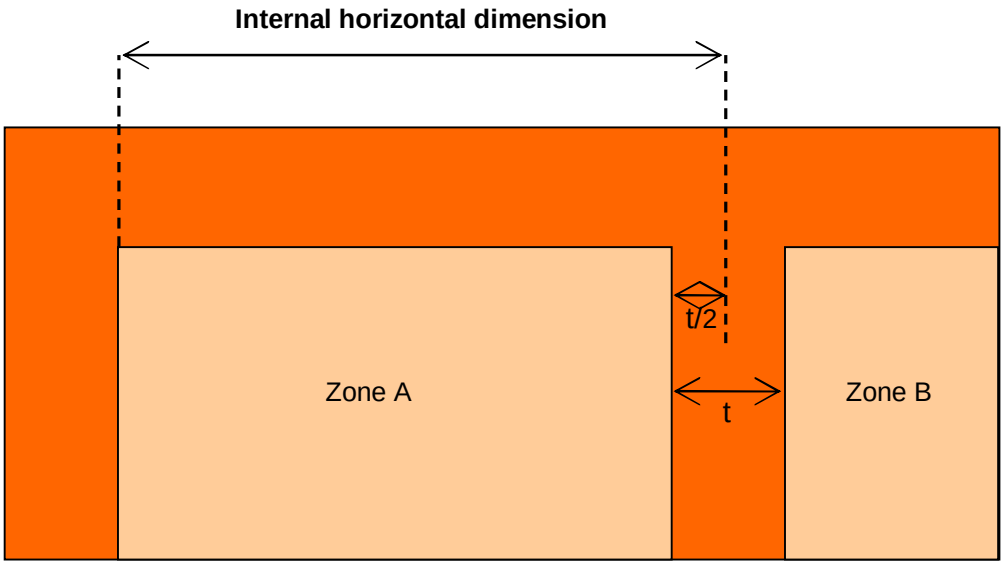


Figure 3: Internal horizontal dimension of a zone

3.5. iSBEM Nomenclature

3.5.1. Naming zones, envelope elements, windows, and doors

There is no set nomenclature for the different items in the *Geometry* form. The only requirement is that they are all unique. You may prefer to assign familiar/representative names. However, with a large building, a methodical nomenclature makes it easier to identify elements and keep track of what has been input.

Below is a suggested nomenclature. If you use *Quick Envelopes* or the "Copy Record" function, the elements you create will be named in this way.

Element	Suggested name	Explanation
Zone	**z#/##**	The **z** stands for zone, and the first number is the storey number (0 for ground floor and 1 for first floor etc.). After the slash, the number(s) stands for the number of the zone on that floor. These can run consecutively throughout the building or start again at 1 for each floor.
Walls	**z#/##/ot**	The first two groups of figures are to identify, as described above, which zone the wall is part of. Then the **o** is the orientation (n/nw/e/se etc.) and **t** is the type (**i** means internal, **u** means underground, and no letter means external).
Floors	**z#/##/ft**	Similar to walls, the first two groups of figures identify the zone. This is followed by an **f** for floor and then the type **t** (**i** for internal floor, **e** for over external space, and no letter for ground floor).
Ceilings/ roofs	**z#/##/ct**	The first two groups of figures identify the zone. This is followed by **c** for ceiling and **t** is the type (**i** is for internal ceiling and no letter means the ceiling has no occupied space above it, i.e., it is a roof).
Window	**z#/##/ot/g**	The first three groups of figures identify which envelope the window is attached to, as described above. The **g** stands for glazing.
Door	**z#/##/ot/d**	The first three groups of figures identify which envelope the door is attached to, as described above. The **d** stands for door.
And for all the above elements	**(name).#**	If there is more than one element which would have the same name following the above nomenclature, "**.1**" is added for the second element and "**.2**" is added to the third, etc. For example, if there were two north walls in a zone (z0/01), with the same orientation and type, then the first wall would be named "z0/01/n" and the second would have a ".1" added to the end and therefore be named "z0/01/n.1".

Table 5: Suggested iSBEM nomenclature

See Table 6 for examples.

Name	Description of element
z0/01	Zone 01 on the ground floor (0)
z0/01/n	First North facing external wall of zone 0/01
z0/01/n.1	Second North facing external wall of zone 0/01
z0/01/n.2	Third North facing external wall of zone 0/01
z0/01/ni	A North facing wall of zone 0/01, which is internal
z0/01/nu	A North facing underground wall of zone 0/01
z0/01/n/g	Glazing in the North external wall of zone 0/01

z0/01/n/d	Door in the North external wall of zone 0/01
z0/01/f	Ground floor of zone 0/01
z0/01/fi	Internal floor of zone 0/01, i.e., there is an interior space below
z0/01/fe	External floor of zone 0/01, i.e., there is an exterior space below
z0/01/c	Roof of zone 0/01, i.e., there is an exterior space above
z0/01/ci	Ceiling of zone 0/01, i.e., there is an interior space above

Table 6: Examples of building element names

Recommendations if you set up your own nomenclature:

- Use names which link subordinate parts of the construction (e.g., windows) to the element of which they are part.
- Incorporate reminders about major distinctions like whether the wall is internal or external, or unusual features like suspended floors over an exterior space.
- Choose characters which avoid using shift keys, e.g., avoid capital letters.

Other points on naming:

- If you use the *Quick Envelopes* (see Section 7.5.8) to create the walls, roofs, floors, ceilings, and windows, the names are created automatically for you. If you follow the suggested nomenclature for the zones, the names for the walls/floors/windows, etc., will be exactly as described above. If you choose another way of naming your zones, the above endings will be added to your zone's name. For example, if you named your first zone, "room1", then the first north wall created for that zone would be automatically called "room1/n".
- It is not possible to have two elements with the same name. If you try to use the same name twice, iSBEM automatically renames the second element for you. For example, if you attempt to create a second zone named "z0/01" or a second wall named "z0/01/n", iSBEM will rename them "z0/01.1" and "z0/01/n.1", respectively.
- If you use the "Copy Record" function, a name is generated automatically for you. For example, if you copy zone "z0/01", the new zone will be automatically named "z0/01.1". However, any building objects (i.e., envelopes, windows, doors) assigned to the zone, which are also copied as a result, retain the same names as those which they are copied from (e.g., z0/01/n, z0/01/n/g, etc). It is recommended that you appropriately rename any copied elements.

3.5.2. Naming constructions and building services systems

As there are generally far fewer constructions and building services systems in a building, such a methodical nomenclature system, as that recommended for the geometrical definition of the building, is not generally required. However, names which clearly identify the type and/or use of the construction or building services system are recommended.

4. iSBEM BASICS – GETTING STARTED

This chapter will show you how to install and open iSBEM, start a new project or open an existing project, and, finally, close the application correctly.

NB: To open and edit files created with previous versions of iSBEM (iSBEM_v3.2.b or earlier), you will first need to convert each file in order to make it compatible with this version of iSBEM. See APPENDIX B: iSBEM file conversion for instructions on how to do this.

The tutorial begins in this chapter. It uses a simple, two storey, rectangular building to demonstrate the different aspects of the application. Details of this building can be found in Appendix A (these details will only be needed for tasks set out in Chapters 7 and 8).

4.1. System Requirements

The current version of iSBEM (iSBEM_v3.5.a.mdb) runs on Microsoft Access 2002 onwards. A run-time version of Access 2002, which would be sufficient, can be requested on CD through the NCM website at www.ncm.bre.co.uk/feedback.jsp. We recommend at least 512 MB RAM on your computer to run the application. To view all of the output documents produced by iSBEM, you will also need Microsoft Internet Explorer, Microsoft Excel, and Adobe Acrobat Reader installed on your computer.

NB: If you have been using MS Access 2000 to run iSBEM, please note that it cannot cope with the changes introduced from iSBEM_v3.2.b onwards.

NB: There is now (from iSBEM_v3.2.b onwards) a version of iSBEM specifically for Office 2007 users, which is also downloadable from www.ncm.bre.co.uk. Please ensure that you request/download and install the iSBEM version suitable for your version of MS Access.

The approved version of iSBEM has been developed to work on a Windows platform only (Windows 2000, Windows XP, Windows Vista, and Windows 7). Unfortunately iSBEM is not compatible with Mac or Linux. SBEM itself will run on most platforms as it is standard C++ and can be compiled in Mac or Linux, but the iSBEM interface is a Microsoft Access application which will not run on Linux or Mac operating systems.

NB: Ensure that you have full read and write access permissions on the NCM folder, where iSBEM is installed by default on your computer. If you are unable to do this, you need to contact the IT department of your company and ask them to adjust your settings to give you full read and write access rights on the NCM folder on your computer.

NB: Please note that (depending on your Accreditation Scheme Provider) in order to generate the XML message for official lodgement and remove the watermark from the EPC and the Recommendations Report, or in order to generate the IAS file required by your Accreditation Scheme Provider, your computer **must** be connected to the internet, and you may (depending on your Accreditation Scheme Provider) need to enter your "Energy Assessor EPCgen.net Activation Code" into the *General* form > *General Information* tab > *Energy Assessor Details* sub-tab > *Energy Assessor Details* sub-form (see Section 7.3.2: General Information tab). If there is no internet connection and/or the Activation Code has not been entered, then the XML message will not be generated, the output files produced will contain the watermark, and the IAS file will not be generated. However, this does not apply if 'EPC Scotland' has been selected as the "Purpose of Analysis".

Further guidance

NB: See APPENDIX E: Activation codes and connection to EPCgen.net, for more guidance.

4.2. Installing iSBEM on your computer

The current version is: **iSBEM_v3.5.a**. The tool can be accessed via the following web address: www.ncm.bre.co.uk.

NB: FILES CREATED WITH PREVIOUS VERSIONS OF iSBEM ARE NOT AUTOMATICALLY COMPATIBLE WITH THIS VERSION AND WOULD REQUIRE CONVERSION BEFORE THEY CAN BE OPENED AND EDITED USING THE NEW VERSION (see APPENDIX B: iSBEM file conversion).

How to install iSBEM:

1. Go to the 'Download' page and complete the form.
2. Click on the hyperlink to download the tool.
3. Save the **iSBEM_v3.5.a.exe** file to a folder of your choice on your hard drive (**do not try to open the file at this point**), such as the Desktop.
4. Once the download is complete, double-click on the **iSBEM_v3.5.a.exe** icon, and then click on "**Unzip**' to initiate the self-extracting process. This will automatically install the application in a new folder on your hard drive (default folder: **C:\NCM**). You may change the installation path if you wish.
5. Once the file has been unzipped to your hard drive, the message "49 file(s) unzipped successfully" will appear (this number may change with future versions of the tool). Click on '**OK**', and then close the **WinZip** Self-Extractor window (click on '**Close**' or on the cross in the top right hand corner of the window).

   iSBEM is now installed on your computer.

6. To locate iSBEM on your computer, open **Windows Explorer**, and navigate through the following (assuming the default installation path was not changed):

   My Computer

   C:\ (drive)

   NCM\

   iSBEM_v3.5.a

iSBEM_v3.5.a.mdb (the tool itself) along with all of its associated databases and files are located within this folder (iSBEM_v3.5.a). **NB:** For users of Office 2007, the Microsoft Access file called **iSBEM_v3.5.a.accdb**.

NB: If you changed the installation path (step 4), the tool will be located in:

your selected path\iSBEM_v3.5.a.

TIP: You may wish to create a shortcut to the "iSBEM_v3.5.a folder" on your **Desktop** or elsewhere in your system so that you can access it more easily. To create a shortcut, right click on the iSBEM_v3.5.a folder, select "Create Shortcut", and then drag and drop the newly created shortcut to the location of your choice, e.g., your Desktop.

4.3. Opening iSBEM

After installing iSBEM and double-clicking on the "iSBEM_v3.5.a" folder, you will be presented with the window in Figure 4. In order to start the application, you will need to double-click on the Microsoft Access file called **iSBEM_v3.5.a.mdb**. **NB:** For users of Office 2007, the Microsoft Access file called **iSBEM_v3.5.accdb**.

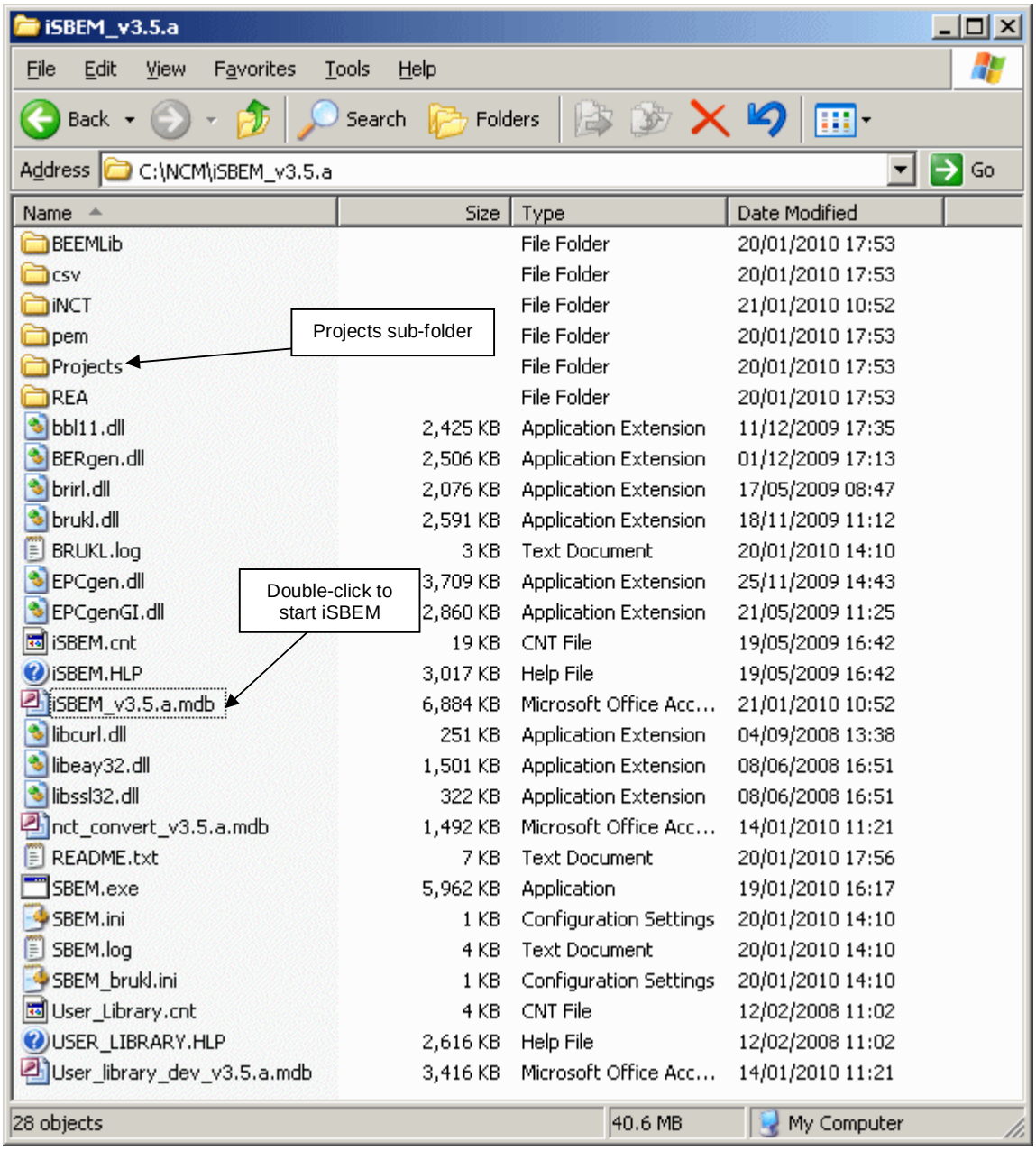

iSBEM_v3.5.a
File Edit View Favorites Tools Help
Back Search Folders
Address C:\NCM\iSBEM_v3.5.a
Go
Name Size Type Date Modified
BEEMLib File Folder 20/01/2010 17:53
csv File Folder 20/01/2010 17:53
iNCT File Folder 21/01/2010 10:52
pem File Folder 20/01/2010 17:53
Projects File Folder 20/01/2010 17:53
REA File Folder 20/01/2010 17:53
bbl11.dll 2,425 KB Application Extension 11/12/2009 17:35
BERgen.dll 2,506 KB Application Extension 01/12/2009 17:13
brirl.dll 2,076 KB Application Extension 17/05/2009 08:47
brukl.dll 2,591 KB Application Extension 18/11/2009 11:12
BRUKL.log 3 KB Text Document 20/01/2010 14:10
EPCgen.dll 3,709 KB Application Extension 25/11/2009 14:43
EPCgenGI.dll 2,860 KB Application Extension 21/05/2009 11:25
iSBEM.cnt 19 KB CNT File 19/05/2009 16:42
iSBEM.HLP 3,017 KB Help File 19/05/2009 16:42
iSBEM_v3.5.a.mdb 6,884 KB Microsoft Office Acc... 21/01/2010 10:52
libcurl.dll 251 KB Application Extension 04/09/2008 13:38
libeay32.dll 1,501 KB Application Extension 08/06/2008 16:51
libssl32.dll 322 KB Application Extension 08/06/2008 16:51
nct_convert_v3.5.a.mdb 1,492 KB Microsoft Office Acc... 14/01/2010 11:21
README.txt 7 KB Text Document 20/01/2010 17:56
SBEM.exe 5,962 KB Application 19/01/2010 16:17
SBEM.ini 1 KB Configuration Settings 20/01/2010 14:10
SBEM.log 4 KB Text Document 20/01/2010 14:10
SBEM_brukl.ini 1 KB Configuration Settings 20/01/2010 14:10
User_Library.cnt 4 KB CNT File 12/02/2008 11:02
USER_LIBRARY.HLP 2,616 KB Help File 12/02/2008 11:02
User_library_dev_v3.5.a.mdb 3,416 KB Microsoft Office Acc... 14/01/2010 11:21
Projects sub-folder
Double-click to start iSBEM
28 objects
40.6 MB
My Computer

Figure 4: Location of the iSBEM Microsoft Access file and Projects folder

The first time that the application is opened, a dialogue box will appear containing iSBEM's licensing terms and conditions (Figure 6). You will need to accept the terms and conditions before you can proceed. If you tick the "Don't show this message again" box, this window will not appear again on starting the application.

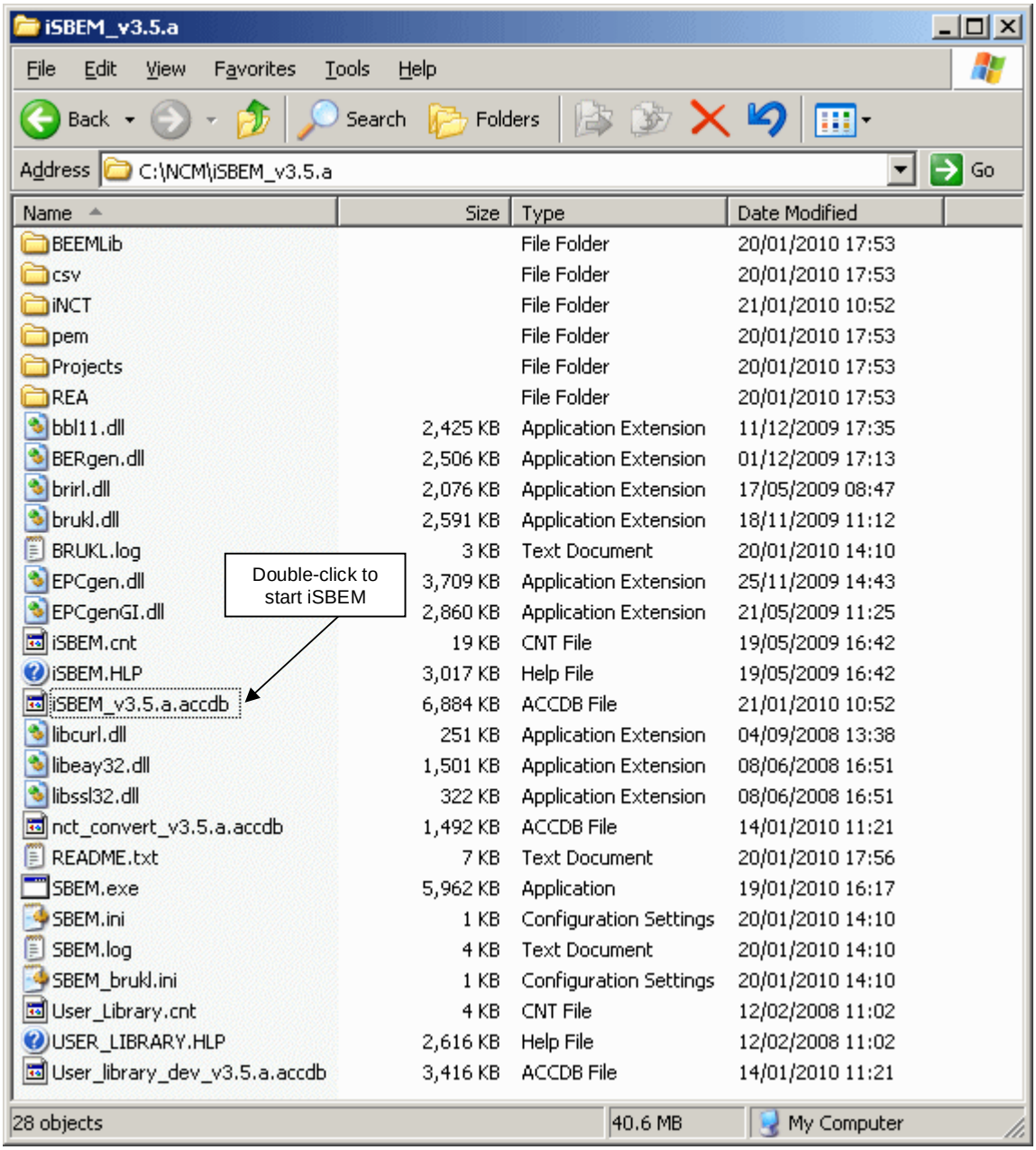

iSBEM_v3.5.a
File Edit View Favorites Tools Help
Back Search Folders
Address C:\NCM\iSBEM_v3.5.a
Go
Name Size Type Date Modified
BEEMLib File Folder 20/01/2010 17:53
csv File Folder 20/01/2010 17:53
iNCT File Folder 21/01/2010 10:52
pem File Folder 20/01/2010 17:53
Projects File Folder 20/01/2010 17:53
REA File Folder 20/01/2010 17:53
bbl11.dll 2,425 KB Application Extension 11/12/2009 17:35
BERgen.dll 2,506 KB Application Extension 01/12/2009 17:13
brirl.dll 2,076 KB Application Extension 17/05/2009 08:47
brukl.dll 2,591 KB Application Extension 18/11/2009 11:12
BRUKL.log 3 KB Text Document 20/01/2010 14:10
EPCgen.dll 3,709 KB Application Extension 25/11/2009 14:43
EPCgenGI.dll 2,860 KB Application Extension 21/05/2009 11:25
iSBEM.cnt 19 KB CNT File 19/05/2009 16:42
iSBEM.HLP 3,017 KB Help File 19/05/2009 16:42
iSBEM_v3.5.a.accdb 6,884 KB ACCDB File 21/01/2010 10:52
libcurl.dll 251 KB Application Extension 04/09/2008 13:38
libeay32.dll 1,501 KB Application Extension 08/06/2008 16:51
libssl32.dll 322 KB Application Extension 08/06/2008 16:51
nct_convert_v3.5.a.accdb 1,492 KB ACCDB File 14/01/2010 11:21
README.txt 7 KB Text Document 20/01/2010 17:56
SBEM.exe 5,962 KB Application 19/01/2010 16:17
SBEM.ini 1 KB Configuration Settings 20/01/2010 14:10
SBEM.log 4 KB Text Document 20/01/2010 14:10
SBEM_brukl.ini 1 KB Configuration Settings 20/01/2010 14:10
User_Library.cnt 4 KB CNT File 12/02/2008 11:02
USER_LIBRARY.HLP 2,616 KB Help File 12/02/2008 11:02
User_library_dev_v3.5.a.accdb 3,416 KB ACCDB File 14/01/2010 11:21
Double-click to start iSBEM
28 objects
40.6 MB
My Computer

Figure 5: Name of the iSBEM Microsoft Access file for Office 2007 users

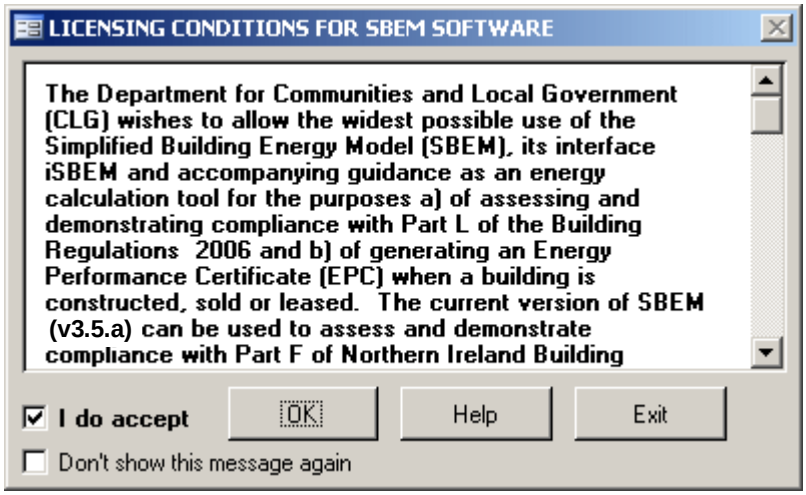

LICENSING CONDITIONS FOR SBEM SOFTWARE
The Department for Communities and Local Government (CLG) wishes to allow the widest possible use of the Simplified Building Energy Model (SBEM), its interface iSBEM and accompanying guidance as an energy calculation tool for the purposes a) of assessing and demonstrating compliance with Part L of the Building Regulations 2006 and b) of generating an Energy Performance Certificate (EPC) when a building is constructed, sold or leased. The current version of SBEM (v3.5.a) can be used to assess and demonstrate compliance with Part F of Northern Ireland Building
I do accept
OK
Help
Exit
Don't show this message again

Figure 6: Terms and Conditions dialogue box

4.4. Creating new and opening existing projects

When the terms and conditions have been accepted, a new window will appear which gives **three** "iSBEM Start-up Options" (Figure 7):

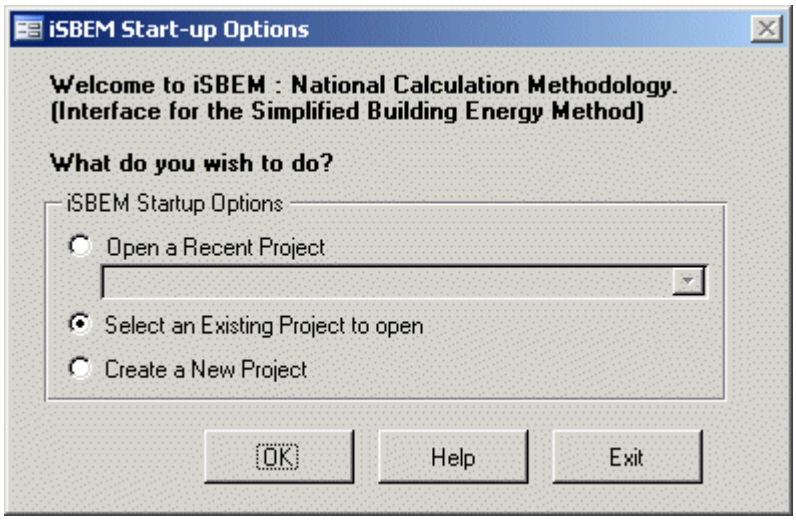


Figure 7: iSBEM Start-up dialogue box

NB: FILES CREATED WITH PREVIOUS VERSIONS OF iSBEM ARE NOT AUTOMATICALLY COMPATIBLE WITH THIS VERSION AND WOULD REQUIRE CONVERSION BEFORE THEY CAN BE OPENED AND EDITED USING THE NEW VERSION (see APPENDIX B: iSBEM file conversion).

1. **Open Recent Projects** – This option has a drop-down menu which contains the 5 most recently-opened projects.
2. **Select an Existing Project** – Selecting this option and clicking on "OK" opens the "Open File" dialogue box, allowing you to browse through your network/computer to locate a project. It is set to automatically open in the "Projects" sub-folder within the iSBEM_v3.5.a folder.
3. **Create a New Project** – If this option is chosen, the "Save New Project" dialogue box appears, and you need to do the following:

a. Click on the “Create new folder” button on the top right hand side of the “Save New Project” dialogue box, enter the project’s name as the name for the folder, and then click on “Open”.
b. Click into the “File Name” field and enter the project name again and click on “Save”. (This folder and project file will be saved to the iSBEM “Projects” folder by default – see Figure 4).
c. A form then opens which allows you to enter some basic information about the project - see Figure 8. This includes:
    - Purpose of the analysis which will be carried out on the building, e.g., Compliance Check with England & Wales Building Regulations Part L.

NB: If either ‘England and Wales Building Regulations Part L’, ‘Scottish Building Regulations’, or ‘Northern Ireland Building Regulations Part F’ is selected as the “Purpose of Analysis”, then the *Building Regulation Check* tab becomes visible in the *Ratings* form to enable running SBEM for compliance checking with Building Regulations. If ‘EPC England’, ‘EPC Wales’, ‘EPC Scotland’, or ‘EPC Northern Ireland’ is selected as the “Purpose of Analysis”, then the *Asset Rating* tab becomes visible instead in the *Ratings* form to enable running SBEM for the generation of Energy Performance Certificates.

- Weather location (pick the closest to your site from the available locations – there are 14 locations for England and Wales, 1 for Scotland, and 1 for Northern Ireland).
- Stage of analysis – whether “as designed” or “as built”. This parameter is not enabled if the Scottish Regulations are selected in the “Purpose of the Analysis” parameter above. Also, only the option “as built” is available when the purpose of analysis is generating EPCs.
- S6 type of building – type of building according to Section 6 of the Scottish Building Regulations, i.e., this parameter is active only if the Scottish Regulations are selected in the “Purpose of the Analysis” parameter above.
- Name of the project.
- Building type - The choice of building type here sets the default building type for the activity areas that you will define later. You will, however, be able to change the building type for each of the activity areas when you come to define them. At this point, you should choose the building type that most closely defines the majority of the building.

You will be able to edit this information at a later stage in the *General* form (Section 7.3: General form).

NB: England and Wales’ ADL2A 2006 would apply to a modular/portable building only if the building will be in use for 2 or more years and 30% or more of the building's external envelope is to be constructed using sub-assemblies/panels/modules manufactured after 6th April 2006. Their treatment within SBEM would be similar to that of other non-domestic buildings.

NB: Only the communal areas of apartment buildings containing self-contained flats should be assessed for compliance using SBEM, for example, circulation areas (using the “Common circulation areas” activity under the building type “DWELLING”). The self-contained flats themselves should be assessed using SAP (for domestic buildings).

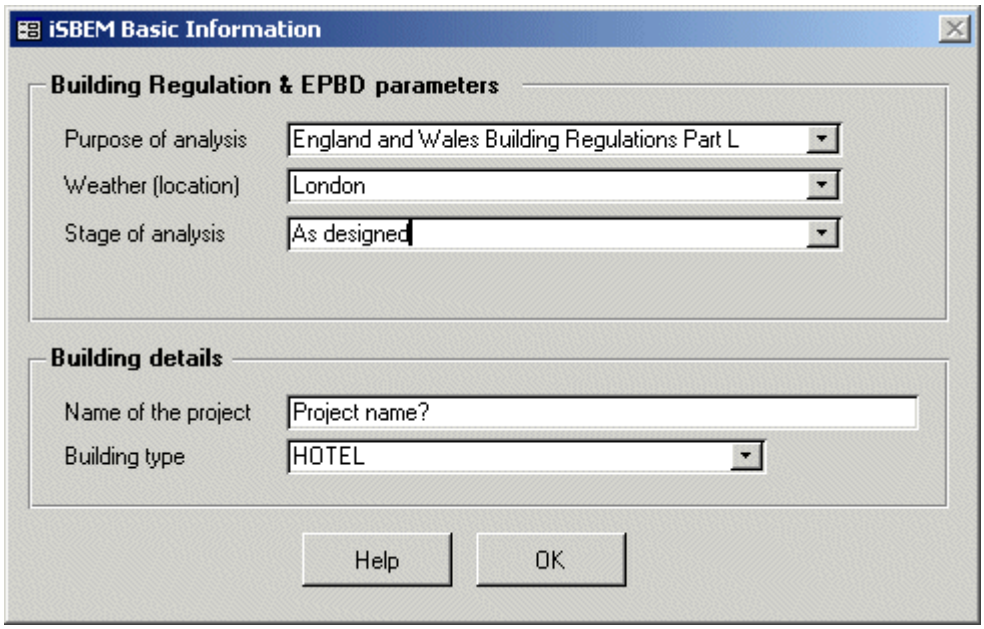


Figure 8: iSBEM Basic Information form

Task 1: Start the application, accept the terms and conditions, select "Open an Existing Project" and click on 'OK'. You will now be within the "Projects" sub-folder within the "iSBEM_v3.5.a" folder. When you installed iSBEM, you also automatically installed 2 files for the Example building: the 'Example building - Complete' and the 'Example building - Tutorial' files. Double-click on the 'Example building - Complete' File. You should now be within the interface which opens in the *General* form.

4.5. Closing iSBEM

There are two ways to close iSBEM (circled in Figure 9):

1. Go to the *General* form and click on "Exit iSBEM".
2. Go to the *General* form and click on the cross in the corner of the iSBEM screen (the smaller window inside the main Microsoft Access window).*

***It is <u>not</u> advisable** to exit by clicking the cross in the corner of the main Microsoft Access screen.

What to do if you close the application incorrectly, or if there is a power cut

If you click on the cross in the corner of the main Microsoft Access screen, your work will not be saved to your project file, but stored within a temporary file until the next time you open the interface. When you do open the interface next, you will be presented with the "iSBEM Project Recovery" dialogue box. It asks you whether you want to continue working with the last project which was not closed properly. Click on "Yes", and then, when you are in the *General* form, click on "Save". If you click "No" here, **<u>all</u>** your changes will be lost. If there is a power cut, your work will be saved into the temporary file as described above, and you should follow the same instructions for recovering your data.

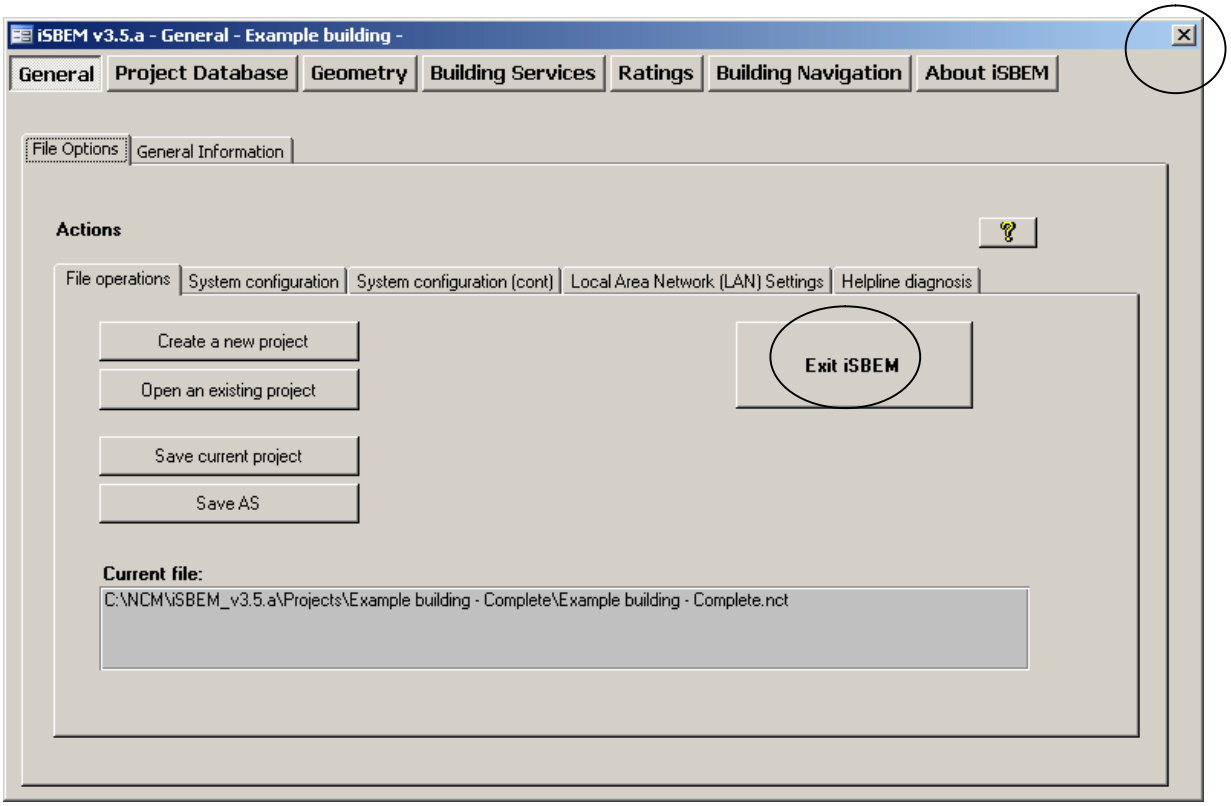


Figure 9: General form showing the correct ways of closing iSBEM

After clicking on either of the 2 options (circled in Figure 9), the iSBEM "END" dialogue box (Figure 10) will open to ask you whether you want to save your changes to the project. The project will be saved to the location determined when you clicked on "Create a New Project" as the project was first entered (the default location was the "Projects" sub-folder within the "iSBEM_v3.5.a" folder).

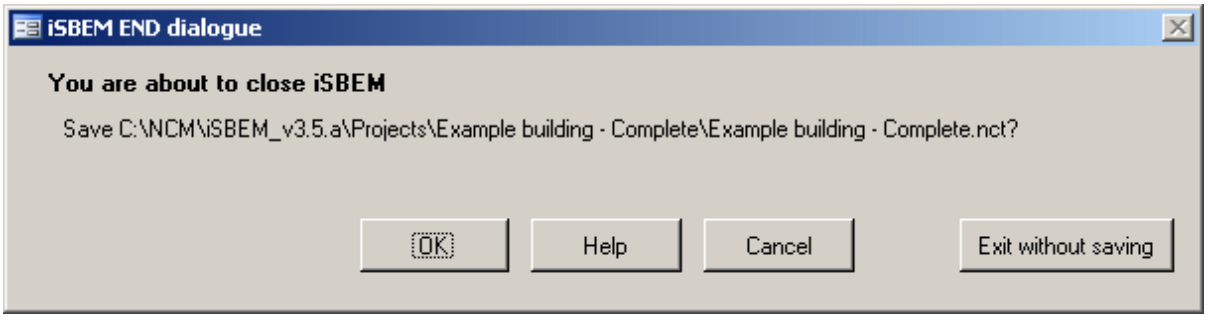


Figure 10: The iSBEM END dialogue box

When you have chosen to save or exit without saving, the iSBEM "END" (Figure 11) dialogue box will open. To exit, click on the button in the centre of the dialogue box.

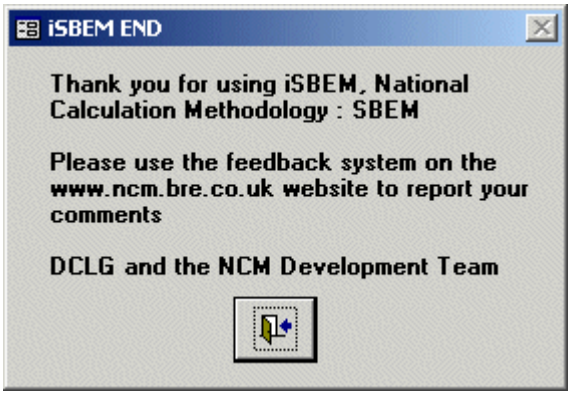

iSBEM END
Thank you for using iSBEM, National Calculation Methodology : SBEM
Please use the feedback system on the www.ncm.bre.co.uk website to report your comments
DCLG and the NCM Development Team

Figure 11: iSBEM END dialogue box

FINAL TASK: You only need to do this task when you have finished your session.

Go to the *General* form and click on "Exit iSBEM". When you are asked whether you would like to save your project, click on "OK".

4.6. Getting assistance with using iSBEM

The following sources are available if you need assistance on the use of iSBEM and have been unable to locate the information you need in this Guide:

- You can click "**F1**" while in any field within the iSBEM interface to get Help information on any specific input item (see Section 6.2: iSBEM Help).
- Frequently Asked Questions (FAQs) can be accessed from the NCM website at www.ncm.bre.co.uk/faqs.jsp.
- For all (software and policy) queries related to Non-Domestic EPCs, you should contact your Accreditation Scheme Provider.
- For policy queries related to Part L, you can contact the Building Control department of your local council or CLG through enquiries.br@communities.gsi.gov.uk.
- You can also refer to CLG's website at www.communities.gov.uk/epbd, including the Frequently Asked Questions at www.communities.gov.uk/planningandbuilding/theenvironment/energyperformance/energyperformancefaqs/epccommercialfaqs.
- CLG's publication: "Improving the energy efficiency of our buildings: A guide to energy performance certificates for the construction, sale and let of non-dwellings" which can be accessed from: www.communities.gov.uk/publications/planningandbuilding/nondwelling.

5. TOUR OF iSBEM

The interface consists of a number of screens into which the data for a building needs to be entered. This chapter gives an overview of these screens.

5.1. Introduction to the main forms in iSBEM

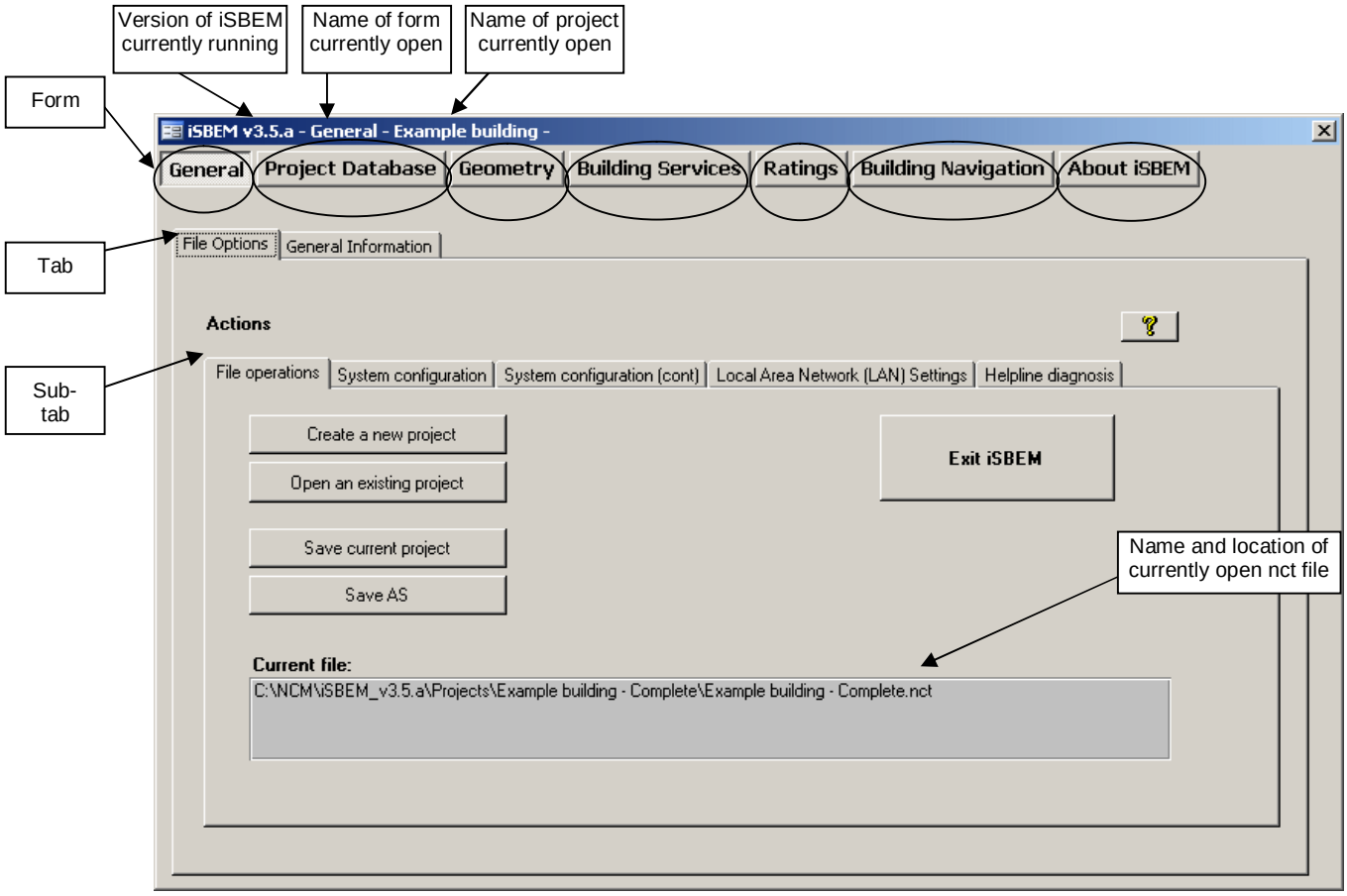
If you have completed Task 1, you should now be within the interface in the *General* form.

The iSBEM opening screen (Figure 12) gives access to **seven** main forms:

- **General**
- **Project Database**
- **Geometry**
- **Building Services**
- **Ratings**
- **Building Navigation**
- **About iSBEM**

NEW

Within each of these forms, there are various tabs and sub-tabs as shown in Figure 12.



Further guidance

Figure 12: The seven forms in iSBEM

NEW As can be seen in Figure 12, the top blue bar of the window displays the version number of iSBEM, the name of the form currently open, and the name of the project. This bar is always visible in all the form, tabs, and sub-tabs of the interface.

Below is a summary of the data which needs to be entered into each form:

General: The *General* form is where projects can be saved and opened. General information relating to the project can also be recorded here, such as the name and address of the project and details about the building's owner and certifier/energy assessor ('agent' replaces 'certifier' for Scottish Building Regulations). This information may have already been entered when the project was first created (see Section 4.4: Creating new and opening existing projects, under 'Create a new project'), but they can be edited here.

Project Database: The *Project Database* form is where the glazing and construction details of your building fabric are entered.

Geometry: The *Geometry* form is where the shape, size, and orientation of the "zones" are entered. Each zone requires a description of the walls, floor, roof/ceiling, doors, and windows which comprise its envelopes.

Building Services: The *Building Services* form is where all the building's systems are described, including: HVAC, HWS, PVS, SES, Wind, and CHP systems. Further information on the lighting and ventilation characteristics specific for each zone is also input through this form.

Ratings: The *Ratings* form is used to carry out the energy performance calculation and compliance checking, access the results, and obtain the Building Regulations compliance document along with the Asset rating for the EPBD and Energy Performance Certificate. The only data entry in this form is related to modifying the energy efficiency recommendations for the report that accompanies the EPC.

Building Navigation: The *Building Navigation* form provides a hierarchical summary of all the building objects that have been defined, assigned and unassigned, along with key details on some of the objects. There is no data entry in this form.

NEW **About iSBEM**: The *About iSBEM* form displays the licensing conditions for the software. There is no data entry in this form.

5.2. Hierarchy of forms, tabs, and sub-tabs in iSBEM

Detailed information on each of the forms, tabs, sub-tabs, and sub-forms within them is provided in the sections indicated below:

Form	Tab	*Sub-tab*	*Sub-form*	Section
General				**7.3**
	File Options			
		File Operations		
		System Configuration		
		Local Area Network (LAN) Settings		
		Helpline Diagnosis		
	General Information			
		Project Details		
		Building Details		
		Certifier/Energy Assessor/Agent Details		
			Certifier/Energy Assessor details	
			Insurance details	
		Owner Details		
Project Database				**7.4**

Constructions for Walls
General
Assigned
Constructions for Roofs
General
Assigned
Constructions for Floors
General
Assigned
Constructions for Doors
General
Assigned
Glazing
General
Assigned

Geometry 7.5

Project
General and geometry
Thermal bridges
Zones
General
Envelope Summary
Quick Envelopes
Envelopes
General
Windows Summary
Doors
General
Windows and rooflights
General

Building Services 7.6

Global & Defaults
HVAC System Defaults *(if the "Purpose of the analysis" selection in the General form > General Information tab > Project details sub-tab is one of the options to generate EPCs)*
Project Building Services
Air Conditioning Inspection *(if the "Purpose of the analysis" selection in the General form > General Information tab > Project details sub-tab is one of the options to generate EPCs, except EPC Scotland)*
HVAC Systems
General
Heating
Cooling
Systems Adjustments
Metering Provision
System Controls *(if the "Purpose of the analysis" selection in the General form > General Information tab > Project details sub-tab is one of the options to generate EPCs)*
Zone Summary
HWS
General
Storage & Secondary Circulation
Assigned
SES
Collector Parameters
Solar Storage & Collector Loop
Auxiliary Energy & Distribution Losses
PVS
General
Wind Generators

General	
CHP Generator	
General	
Zones	
HVAC, HWS, and Lighting Systems	
Ventilation	
Exhaust	
Lighting (General)	
Lighting (Controls)	
Display Lighting	
Ratings	**8.1**
Building Regulations Check	
Building Rating	
Calculation Logs	
SBEM.log	
BRUKL.log	
Calculation Errors	
SBEM.err	
BRUKL.err	
OR (if the "Purpose of the analysis" selection in the General form > General Information tab > Project details sub-tab is one of the options to generate EPCs)	
Asset Rating	
Building Rating	
Graphic Rating	
Recommendations	
EPC Audit	
Construction	
Geometry	
HVAC & HWS	
Lighting	
Calculation Logs	
SBEM.log	
EPCgen.log	
BRUKL.log	
Calculation Errors	
SBEM.err	
EPCgen.err	
BRUKL.err	
Building Navigation	**7.7**
Selections	
Object Properties	
NEW **About iSBEM**	**7.8**

Table 7: Structure of the forms, tabs, and sub-tabs in iSBEM

Task 2*:* In the 'Example building - Complete' file, click on each of the 6 forms and each of their tabs and sub-tabs to familiarise yourself with how to get from one location in iSBEM to another. (At present, there is a small, but unavoidable, time delay when switching between forms.)

6. BASIC iSBEM FUNCTIONALITY AND THE HELP MENU

6.1. Basic interface functionality and buttons

Within the *Project Database*, *Geometry*, and *Building Services* forms, you are required to enter information about various aspects of the building. The *Project Database* form requires you to enter the information about the properties of each of the construction and glazing types. The *Geometry* and *Building Services* forms require you to enter details about the zones, their envelope elements, windows, and doors and all of the building services systems found in the building (all these items are shown in Figure 1: Structure of SBEM objects).

All of these items are 'records' within the interface, and there is a *General* sub-tab**,** like the one shown below (Figure 13), for each, where you can view, add, delete, and edit them.

Within iSBEM, there is an alternative way of entering some types of records, in particular, the envelope elements and windows. These can be entered using the *Quick Envelope* sub-tab. The functionality of this and any other screens in iSBEM will be explained in the relevant sub-section of Chapter 7.

The majority of the buttons and functionality of iSBEM can, however, be demonstrated by the *General* sub-tab (Figure 13).

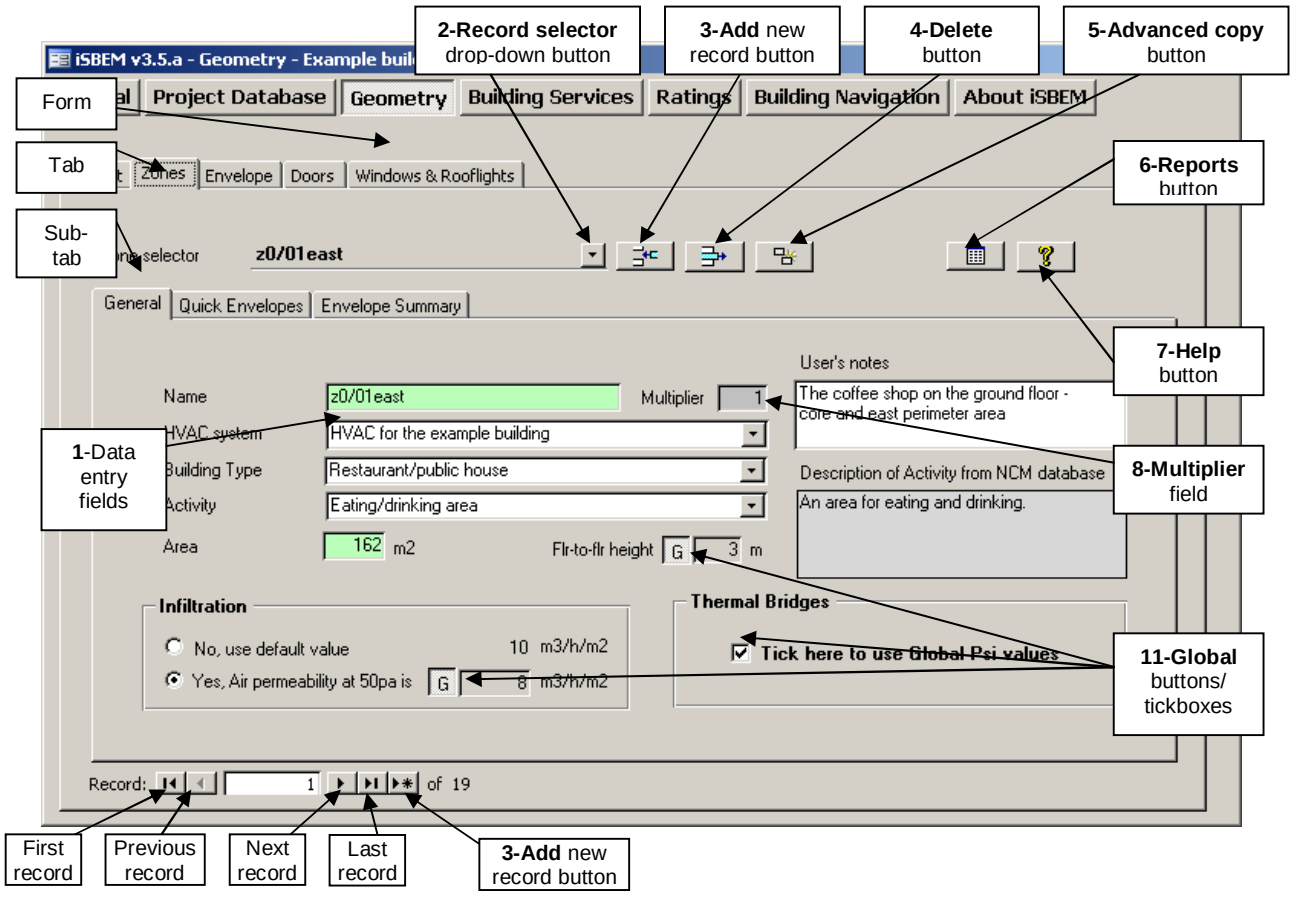


Figure 13: A General sub-tab: basic commands and buttons

1. Data entry fields

The data entry fields in iSBEM require the user to either enter text/numbers or select an option from a drop-down list. Some of the fields are green. These fields are mandatory and must be filled in before proceeding to the next record or navigating away from that screen.

2. Record selector button

Clicking on the record selector drop-down button produces a drop-down list of all of the records in that sub-tab. For example, in the *Project Database* form > *Constructions for Walls* tab, clicking on the record selector drop-down button displays all of the constructions for walls that have already been defined in that project.

To the right of the name of the record, there is further information about the parent building objects for that record. For example, in the *Zones* tab, clicking the record selector button displays all of the zones in the building along with the HVAC system with which each zone is associated.

Extra features:

"Copy single object" function (this function will be available in future versions of the tool): The first entry in the drop-down list begins with "Choose action or X from the list" where X can be a construction, zone, wall, HVAC system, etc. The only action currently planned to become available is to "Copy a single object". This will allow (when it becomes functional in future versions) the user to copy only the selected object with none of its associated/child objects (To copy the object and all of the associated objects, you will need to use the "Advanced Copy" button, which is discussed below).

3. Add new record button

If you hover over this button with the mouse cursor, the text "Click here to insert a new X" will appear, where X could be a construction object, zone, HVAC system, etc. You can also click on the "Add new record" button at the bottom of the screen. You will then be prompted to enter a name for the record. Once you have done this, press on the **Tab** or **Enter** button on your keyword. You will then be able to start entering the rest of the information necessary for that record.

NB: The name should be entered in the "Name" field. Do **not** try to add a name in the "Record selector" field.

4. Delete record button

If you hover over this button with the mouse cursor, the text "Click here to delete current X" will appear. To delete a record, select the record you want to delete from the drop-down "Record selector" menu, and click on the "Delete" record button. Not only will the record be deleted but any associated sub-objects as well. For example, if you delete an envelope element, any associated windows and doors will also be deleted (If a Microsoft Access message box appears showing "Reserved error" or "No current record", click on "OK" to proceed). A dialogue box will then appear to confirm that you intend to delete the record. Any deletion cannot be undone. It is very important that you determine which associated sub-objects are going to be deleted at the same time. If you are sure you want to delete the record and all its associated records, click on "Yes".

5. Advanced copy button

The "Advanced Copy" button is available in the *Geometry* and *Building Services* forms. By clicking on this button, the selected building object, along with all of its associated sub-objects,

are copied. The new record is given an automatic name. For example, if you copied envelope X, a new envelope would be created and named “X.1”. At the same time, all of its associated objects would also be copied. For example, if an envelope element were copied, any associated windows and doors would also be copied. The copied windows and doors, however, keep the same name as those they were copied from. For a zone, this would mean all of its associated envelope elements, windows, and doors would be copied, and if any HVAC systems were copied, so would every associated zone, along with all of its envelope elements, windows, and doors.

If you need to only copy the selected record and not any of its sub-objects, use the copy single object function found in the record selector menu (this function will be available in future versions of the tool).

6. Reports button

Clicking on the “Reports” button produces two reports: the *Data Summary* report and the *Unassigned Objects* report. These reports are for double-checking the data entered. For more details on these two reports, see Section 7.9: Double-checking the data.

7. Help button

The “Help” button can be found in the top right hand corner of every sub-tab of iSBEM. Clicking on this button opens the Help menu (see Section 6.2: iSBEM Help, for further information).

8. Multiplier field

Further guidance

If there is more than one identical zone, for example, this field allows the user to only define it once and then enter the number of these identical zones that exist in the building. Remember that this would also “multiply” all of its associated envelope elements, windows, doors, and additional thermal bridges during the calculation.

9. Record navigation buttons

These buttons allow you to scroll through the records in that sub-tab.

10. The Escape key – navigating away from incomplete records

Once a new record has been created, iSBEM will not allow you to navigate away from that screen until you have completed all the mandatory fields (all the green fields). SBEM does not have default values for these fields, and they are needed for SBEM to can carry out its calculations. You will also not be able to delete the record until it has been completed.

If you need to navigate away from the screen before it is completed, press the **Escape** key on your keyboard.

11. The Global buttons or tick boxes

Global buttons and tick boxes allow you to use previously defined ‘global’ values for a variety of parameters. For example, in Figure 13 , the global ‘air permeability at 50pa’ button is pressed in. This means that the current record (in this case, zone z0/01east) takes the previously defined ‘global’ air permeability value (this global value is defined in the *Geometry* form > *Project* tab > *General and Geometry* sub-tab – see Table 8: Global parameters).

When the Global button or tick box is not pressed in or ticked, you are able to enter a value specifically for that record. This is shown in Figure 13 where the floor-to-floor height 'global' button is not pressed in, and a value of 3 has been introduced for that zone.

Table 8: Global parameters - shows the global parameters available in iSBEM, where they are defined, and where they are later used.

Parameter	Global value defined:	Location of Global button or tick box
Air permeability	*Geometry* form > *Project* tab > *General and Geometry* sub-tab	*Geometry* form > *Zones* tab > *General* sub-tab
Zone height	*Geometry* form > *Project* tab > *General and Geometry* sub-tab	*Geometry* form > *Zones* tab > *General* sub-tab
Thermal bridges	*Geometry* form > *Project* tab > *Thermal bridges* sub-tab	*Geometry* form > *Zones* tab > *General* sub-tab
Condition of adjoining space for envelope elements	*Project Database* form > *Construction for Walls* tab > *General* sub-tab *Project Database* form > *Construction for Floors* tab > *General* sub-tab *Project Database* form > *Construction for Roofs* tab > *General* sub-tab	*Geometry* form > *Envelope* tab > *General* sub-tab *Geometry* form > *Zones* tab > *Quick Envelopes* sub-tab

Table 8: Global parameters

6.2. iSBEM Help

iSBEM Help can be accessed in two ways:

1. By pressing the "Help" button which appears on every sub-tab in the interface as described in Section 6.1. This opens the "Help Topics" window from which you can navigate to the item of interest (see Figure 14).
2. By clicking into the field of interest and pressing the **F1** key on your keyboard. This opens the specific Help entry relating to that particular field in the "Help Entries" window (see Figure 15). From there, you can click either "Contents", "Index", or "Find" to open the "Help Topics" dialogue box.

There are Help entries on each of the fields in the interface, and there is a selection of "How to" entries, such as, how to close iSBEM, how to name the building objects, or how to go about describing a roof. Most of this information can also be found in this User Guide.

Help Topics window (Figure 14)

All of the Help topics are listed in the "Help Topics" window. It contains three screens from which you can navigate to your chosen topic: the "Contents" screen, the "Index" screen, and the "Find" screen.

- The "Contents" screen lists all the entries under the iSBEM form, tab, or sub-tab to which they relate or under the "How to.." menu.

- The “Index” screen lists all the entries in alphabetical order.
- The “Find” screen contains a search engine which brings back all the Help entries which contain in their contents, a given word or phrase.

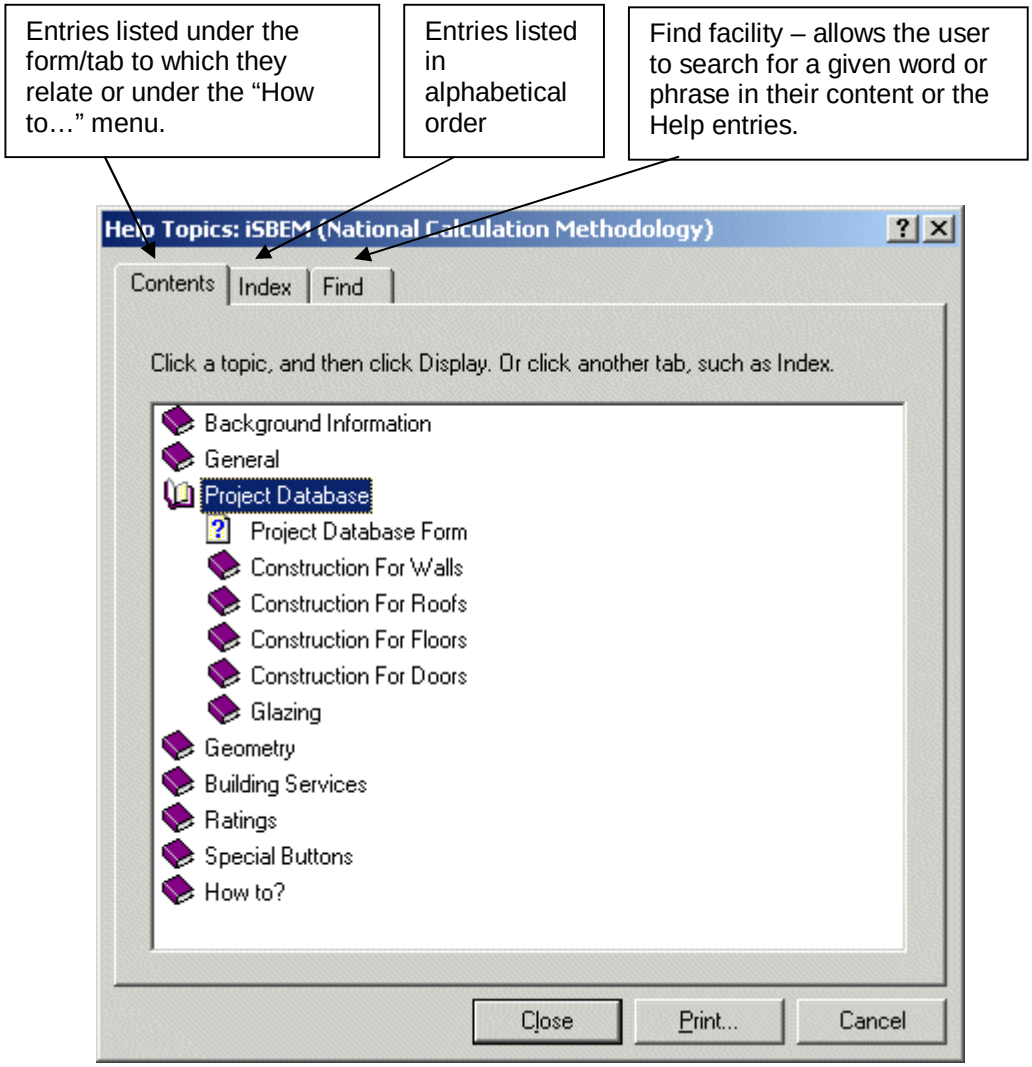


Figure 14: Help Topics window

Help Entries window (Figure 15)

Double-clicking on the item of interest in the “Help Topics” window, or clicking on **F1** on your keyboard, while the cursor is in the relevant field in the interface, opens the “Help Entries” window on the page of interest and closes the “Help Topics” window. Within the “Help Entries” window, it is possible to scroll through the “Help Entries” using the scrolling buttons. Clicking on either the “Contents”, “Index”, or “Find” buttons opens the “Help Topics” window.

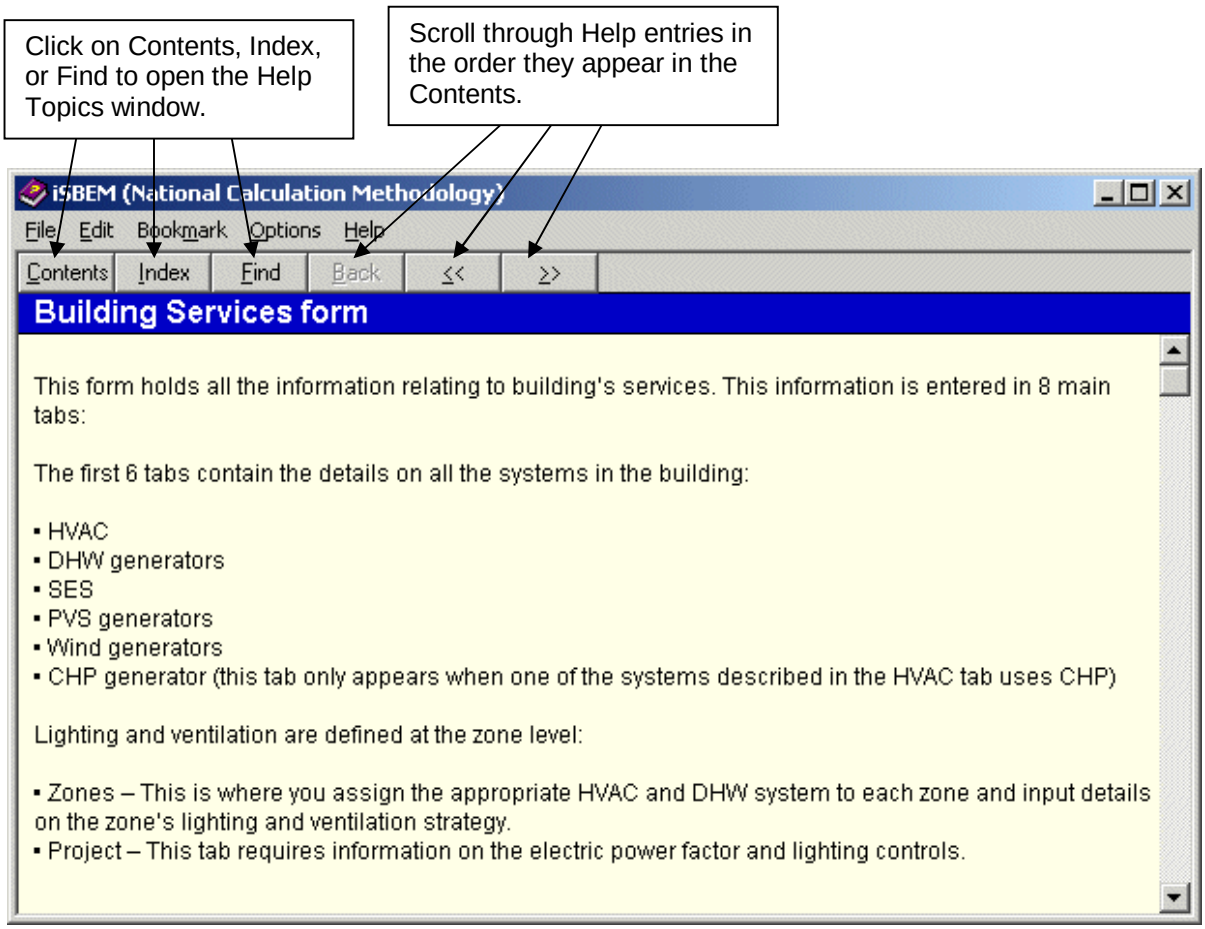

Click on Contents, Index, or Find to open the Help Topics window.
Scroll through Help entries in the order they appear in the Contents.
iSBEM (National Calculation Methodology)
File Edit Bookmark Options Help
Contents Index Find Back << >>
Building Services form
This form holds all the information relating to building's services. This information is entered in 8 main tabs:
The first 6 tabs contain the details on all the systems in the building:
▪ HVAC
▪ DHW generators
▪ SES
▪ PVS generators
▪ Wind generators
▪ CHP generator (this tab only appears when one of the systems described in the HVAC tab uses CHP)
Lighting and ventilation are defined at the zone level:
▪ Zones – This is where you assign the appropriate HVAC and DHW system to each zone and input details on the zone's lighting and ventilation strategy.
▪ Project – This tab requires information on the electric power factor and lighting controls.

Figure 15: Help Entries window

7. ENTERING A BUILDING INTO iSBEM

This chapter takes you through each of the iSBEM data entry forms consecutively (the *General*, *Project Database*, *Geometry*, and *Building Services* forms), giving guidance on what information is required at each stage.

For this section of the tutorial, you will be using the 'Example building – Tutorial' file. Some of the information for the Example building has already been entered into this file, but in each step, there will be a few fields that need to be filled in.

The Example building

The Example building is a two storey rectangular building. A coffee shop and a supermarket are located on the ground floor while the first floor is office space. The original drawings for each floor, as well as the characteristics of the building fabric are shown in APPENDIX A:. A 3D-view of the Example building is shown in Figure 16.

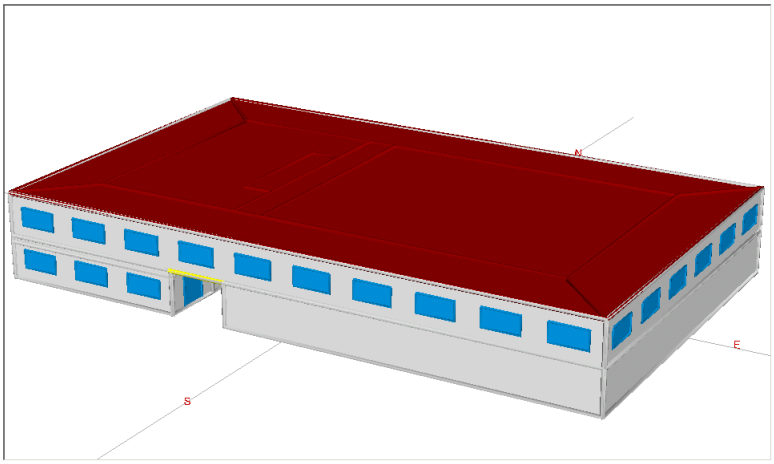


Figure 16: 3D view of the Example building

Before continuing with the tutorial, it is recommended that you have a brief read through APPENDIX A: to familiarise yourself with the building and, in particular, how the building has been zoned.

Task 3*:* Close the completed version of the example ('Example building - Complete' File), that you have been using to take a tour of the interface in Task 2, and open the tutorial version of the example, 'Example building – Tutorial' file.

To do this, go to the *File Options* tab in the *General* form and click "Open an existing project". You will then be asked if you want to save the complete version. Click on "Exit without saving". You will then be presented with the start-up options dialogue box. Click on "Select an existing project to open", and then select 'Example building – Tutorial' File.

7.1. Order of data entry

Some items need to be defined before others in iSBEM. For example, the building fabric needs to be defined before the walls, doors, and windows can be fully described. This hierarchy

between the different elements defined in iSBEM can be seen in Figure 1: Structure of SBEM objects. However, there is a degree of flexibility too.

Figure 17 shows which elements need to be entered before others and also gives a suggested order of data entry. It is this order that is followed in the tutorial.

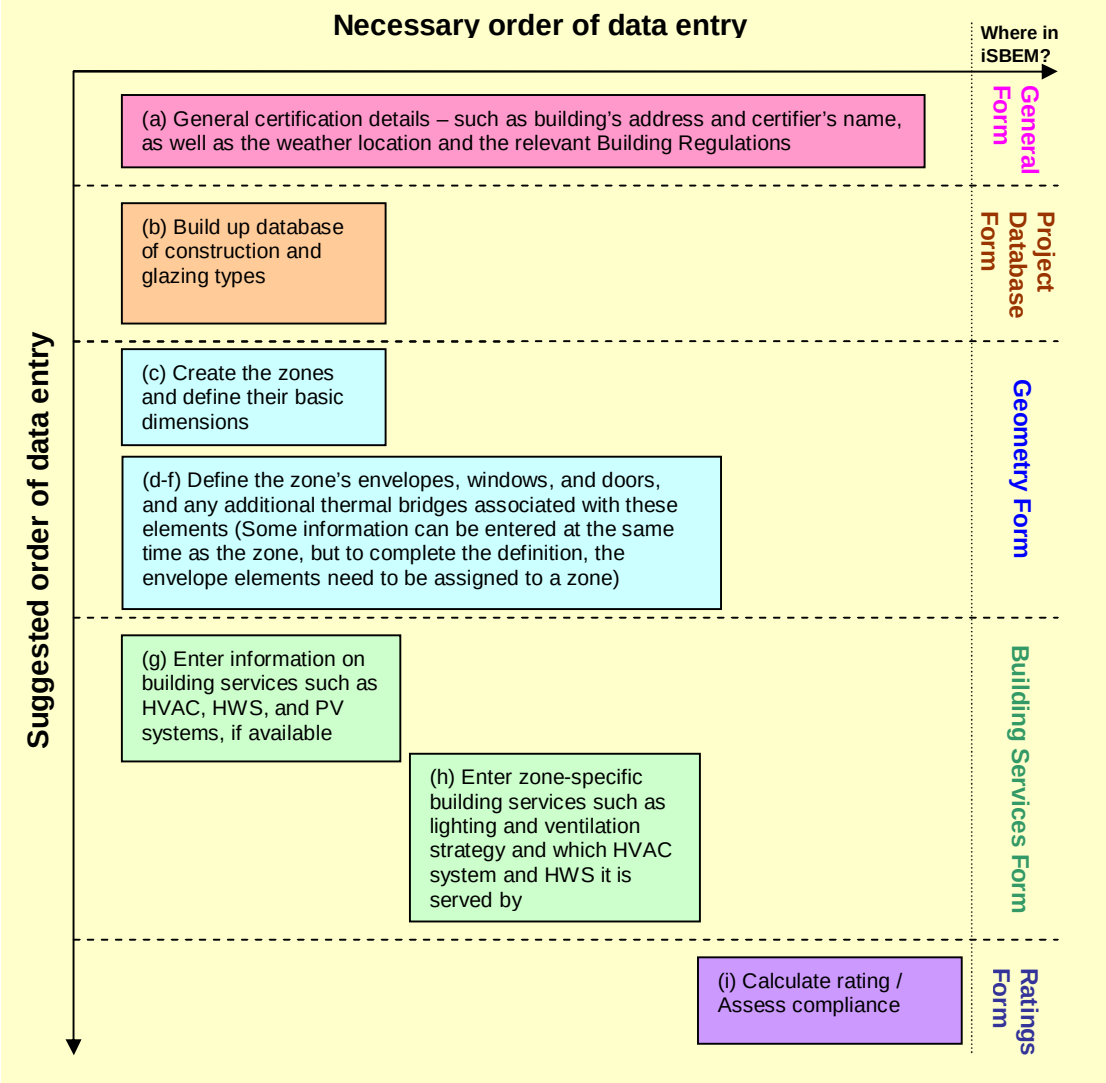

Necessary order of data entry
Where in iSBEM?
Suggested order of data entry
(a) General certification details – such as building's address and certifier's name, as well as the weather location and the relevant Building Regulations
General Form
(b) Build up database of construction and glazing types
Project Database Form
(c) Create the zones and define their basic dimensions
(d-f) Define the zone's envelopes, windows, and doors, and any additional thermal bridges associated with these elements (Some information can be entered at the same time as the zone, but to complete the definition, the envelope elements need to be assigned to a zone)
Geometry Form
(g) Enter information on building services such as HVAC, HWS, and PV systems, if available
(h) Enter zone-specific building services such as lighting and ventilation strategy and which HVAC system and HWS it is served by
Building Services Form
(i) Calculate rating / Assess compliance
Ratings Form

Figure 17: Order of data entry

(The stages, indicated by the letters in Figure 17 (a – i) correspond to the stages described in Section 2.6: Overview of how a building is defined in iSBEM).

7.2. Important note on the default values in iSBEM

In iSBEM, there are default values included for various parameters. For example, there are default seasonal efficiencies for HVAC systems and default constructions for envelope elements so that you can select them when defining the envelopes of a zone. These default values are not generous (usually pessimistic), should be checked by the user, and, if appropriate, changed or added to.

NB: If none of the default values in iSBEM are changed, it is likely that the building will not comply with Building Regulations.

7.3. General form

The *General* form contains two tabs:

- **File Options** tab
- **General Information** tab

7.3.1. File Options tab

The *File Options* tab has five sub-tabs:

- **File Operations** sub-tab.
- **System Configuration** sub-tab.
- **System Configuration (cont.)** sub-tab.
- **Local Area Network (LAN) Settings** sub-tab.
- **Helpline Diagnosis** sub-tab.

File Operations sub-tab:

This sub-tab contains the options to “Save current project”, “Save As”, “Open an Existing Project”, “Create a New Project”, and “Exit iSBEM” (shown in Figure 18).

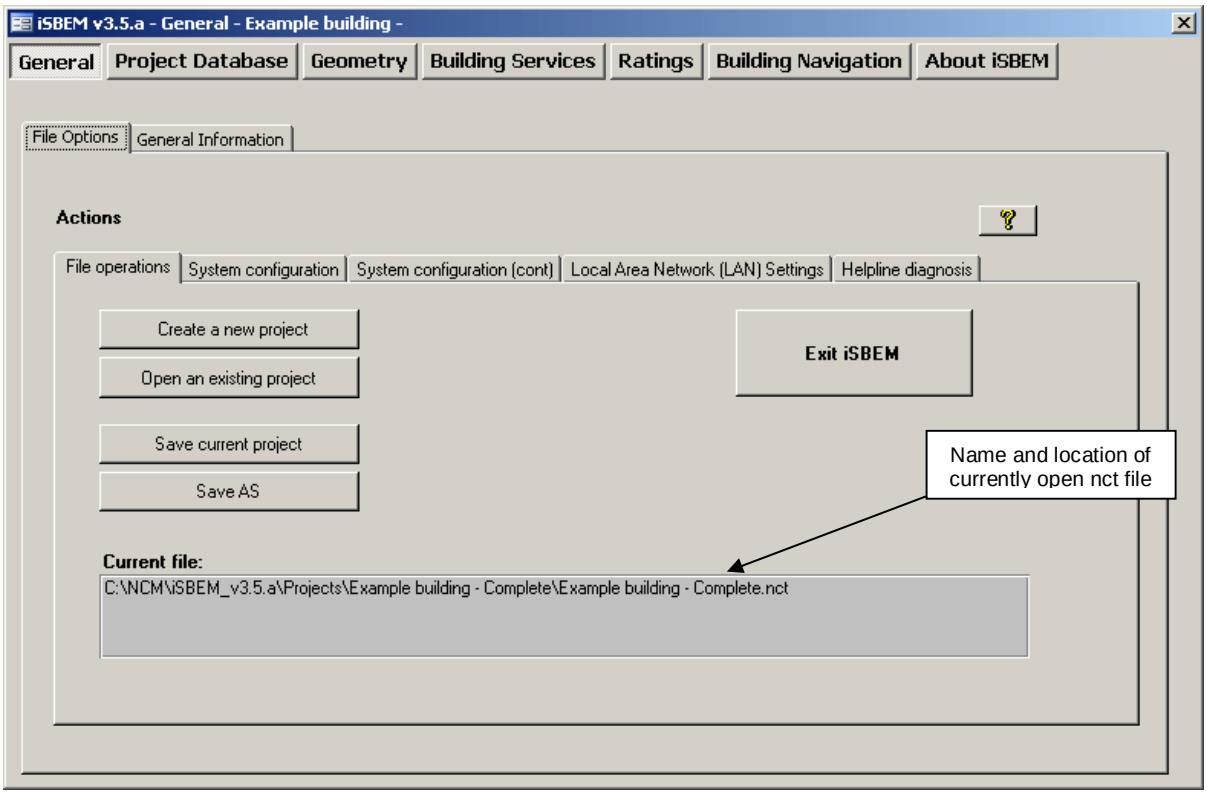


Figure 18: The File Options tab in the General form

System Configuration sub-tab:

iSBEM creates different output reports (more details can be found in Chapter 8). Two of these reports have the file extension ‘.htm’. In order to run the htm reports (by accessing your web browser, Microsoft Internet Explorer), iSBEM needs to know the *Program Files* folder path on

your computer. The default path (C:\Program Files\), shown in Figure 19, should be fine for most systems. If, however, you have a different configuration on your computer, and the reports are not created, you will need to manually edit the configuration in this tab to reflect the settings on your computer.

iSBEM also needs to know the folder where the projects and the iSBEM output reports will be saved. This is specified by the *Project Files* folder. The default path, shown in Figure 19, should be fine for most systems. If however, the reports are not created, you will need to manually edit the configuration in this tab.

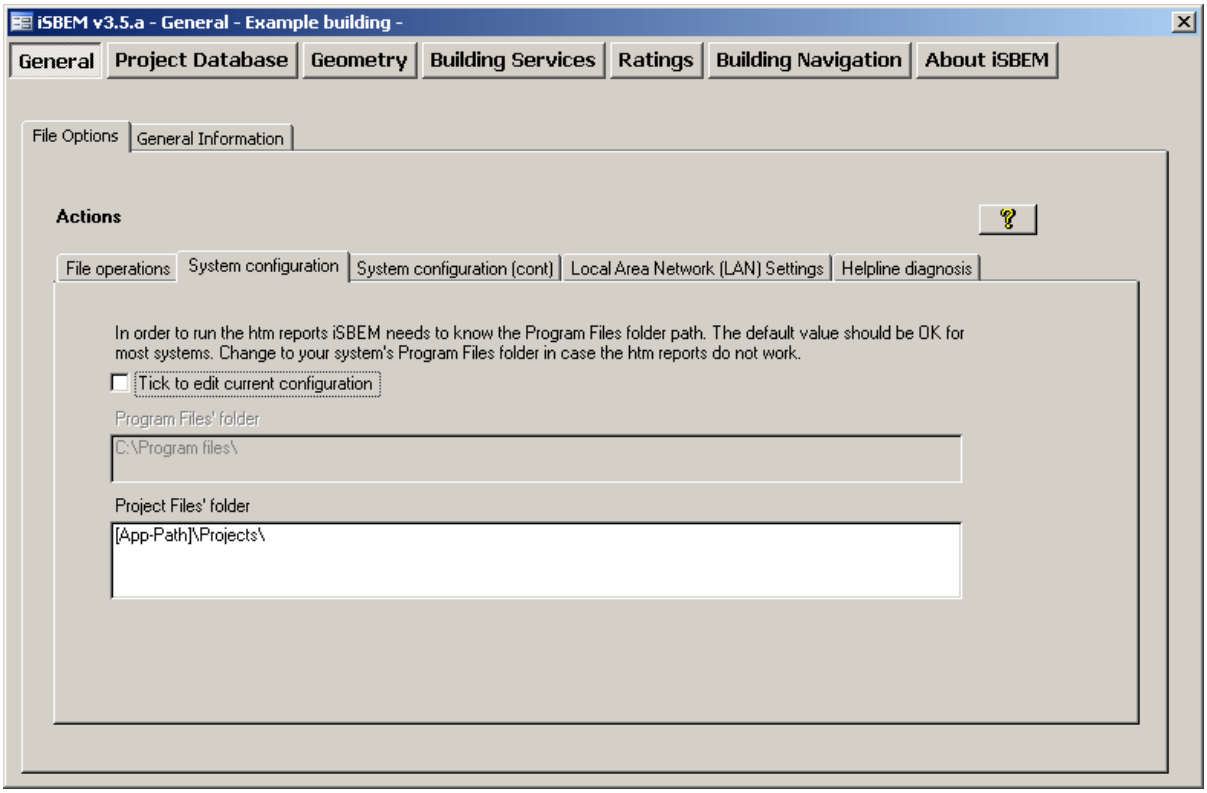

iSBEM v3.5.a - General - Example building -
General
Project Database
Geometry
Building Services
Ratings
Building Navigation
About iSBEM
File Options
General Information
Actions
File operations
System configuration
System configuration (cont)
Local Area Network (LAN) Settings
Helpline diagnosis
In order to run the htm reports iSBEM needs to know the Program Files folder path. The default value should be OK for most systems. Change to your system's Program Files folder in case the htm reports do not work.
Tick to edit current configuration
Program Files' folder
C:\Program files\
Project Files' folder
[App-Path]\Projects\

Figure 19: The System Configuration sub-tab

System Configuration (cont.) sub-tab:

This sub-tab (Figure 20) contains tick boxes which users can modify to reflect their preferences while using iSBEM:

1. Tick box which is unticked by default. You need to tick it if you would like SBEM to generate the *Data Reflection* reports (for the actual and notional buildings) in html format (as well as csv format which is always done) during the calculation, and the relevant access button will appear in the *Ratings* form. If the box remains unticked, then these reports will be generated in csv format only (see Section 8.2.3: Data Reflection Report – Actual Building and 8.2.3: Data Reflection Report – Actual Building).
2. Tick box, which is ticked by default and should remain ticked, if you wish for the contents of the *Building Navigation* form to be refreshed automatically with any changes in the objects properties that might have been performed since the form was last accessed. If you do not wish for the *Building Navigation* form to be refreshed automatically, you should untick this box. There is a button in the *Building Navigation* form which you can click in order to initiate the “refresh” function manually (see Section 7.7: Building Navigation form).
3. Tick box, which is ticked by default, to automatically clear the contents of the *Quick Envelopes* tab once the envelopes have been created (i.e., the create envelopes button has

been pressed). You can untick this box if you do not wish for the contents of the tab to be cleared (see Section 7.5.8: Quick Envelopes tab: Short cut to creating envelopes and windows).

4. Tick box, which is ticked by default, to allow the definition of the areas of glazing in envelopes to be input as areas, in m^2, rather than percentages in the *Quick Envelopes* tab. If you wish to define glazing areas using percentages, then you can untick the box (see Section 7.5.8: Quick Envelopes tab: Short cut to creating envelopes and windows).

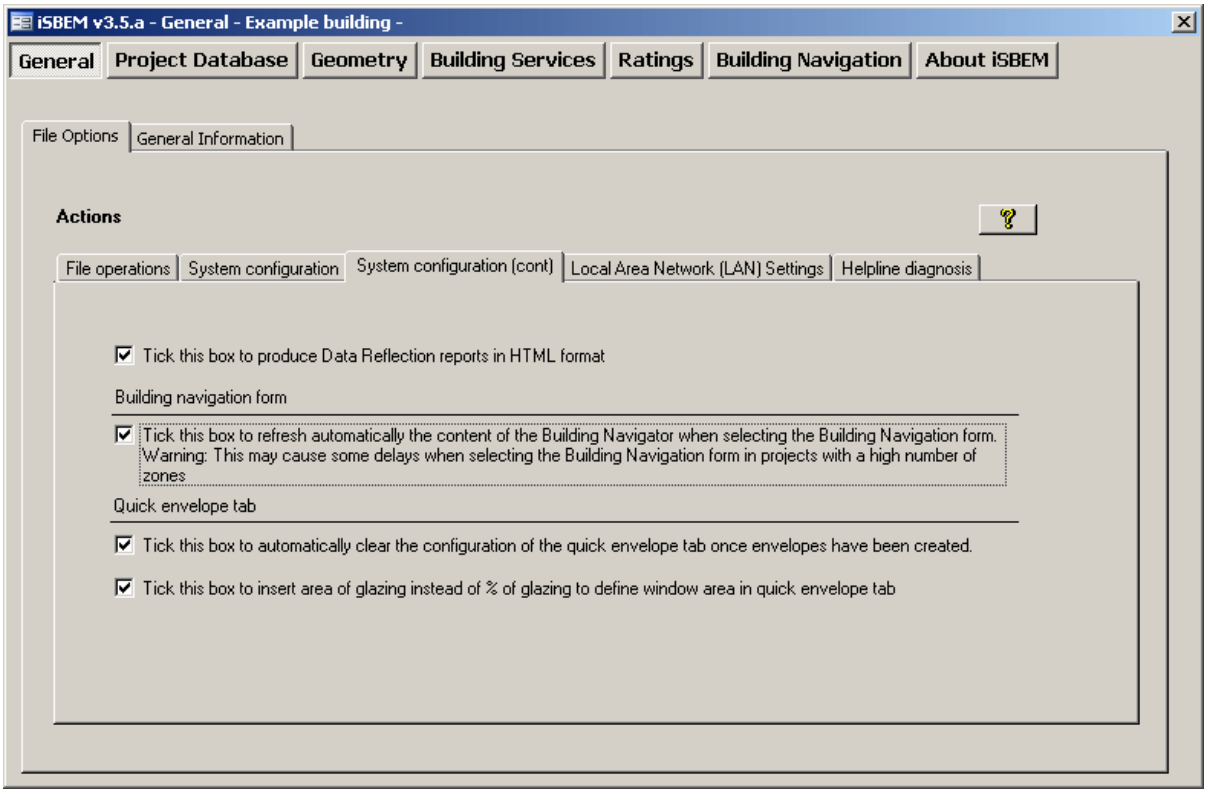

iSBEM v3.5.a - General - Example building -
General
Project Database
Geometry
Building Services
Ratings
Building Navigation
About iSBEM
File Options
General Information
Actions
File operations
System configuration
System configuration (cont)
Local Area Network (LAN) Settings
Helpline diagnosis
Tick this box to produce Data Reflection reports in HTML format
Building navigation form
Tick this box to refresh automatically the content of the Building Navigator when selecting the Building Navigation form. Warning: This may cause some delays when selecting the Building Navigation form in projects with a high number of zones
Quick envelope tab
Tick this box to automatically clear the configuration of the quick envelope tab once envelopes have been created.
Tick this box to insert area of glazing instead of % of glazing to define window area in quick envelope tab

Figure 20: The System Configuration (cont.) sub-tab

Local Area Network (LAN) Settings sub-tab:

In this sub-tab, the following information can be entered (Figure 21):

Proxy Server

1. Tick box to indicate whether a proxy server is used (by a Local Area Network) for connecting your computer to the Internet. If the box is ticked, i.e., a proxy server is used, then the following fields become active:
    a. Address - the URL address of the proxy server used.
    b. Port - the port of the proxy server used.
    c. Tick box to indicate whether the proxy server requires a password. If the box is ticked, then the following field becomes active:
        i. User name – the user name for the proxy server.
        ii. Password – the password for the proxy server.

NB: All information on the proxy server, if one is used, should be available from your IT Department.

NB: (For assessors accredited by an Accreditation Scheme Provider that allows Energy Assessors to generate the final EPC documents for lodgement through the Energy Assessors' computers). Please note that in order to generate the XML message for official lodgement and remove the watermark from the EPC and the Recommendations Report, your computer **must** be connected to the internet, and you need to enter your "Energy Assessor EPCgen.net Activation Code" into the *General* form > *General Information* tab > *Energy Assessor Details* sub-tab > *Energy Assessor Details* sub-form (see Section 7.3.2: General Information tab). If there is no internet connection and/or the Activation Code has not been entered, then the XML message will not be generated and the output files produced will contain the watermark. However, this does not apply if 'EPC Scotland' has been selected as the "Purpose of Analysis".

NB: (For assessors accredited by an Accreditation Scheme Provider that generates the final EPC documents for lodgement in a central system for the Accreditation Scheme). Please note that in order to generate the IAS file required by the Accreditation Scheme Provider, your computer **must** be connected to the internet. If there is no internet connection, then the IAS file will not be generated. The output files produced on your computer will always contain the watermark.

Further guidance

NB: See APPENDIX E: Activation codes and connection to EPCgen.net, for more guidance.

2. Tick box to follow a different connection route to be ticked **only** if requested by the SBEM Helpline after you have experienced problems connecting to the EPCgen.Net site. This box is unticked by default and should not be ticked unless requested.

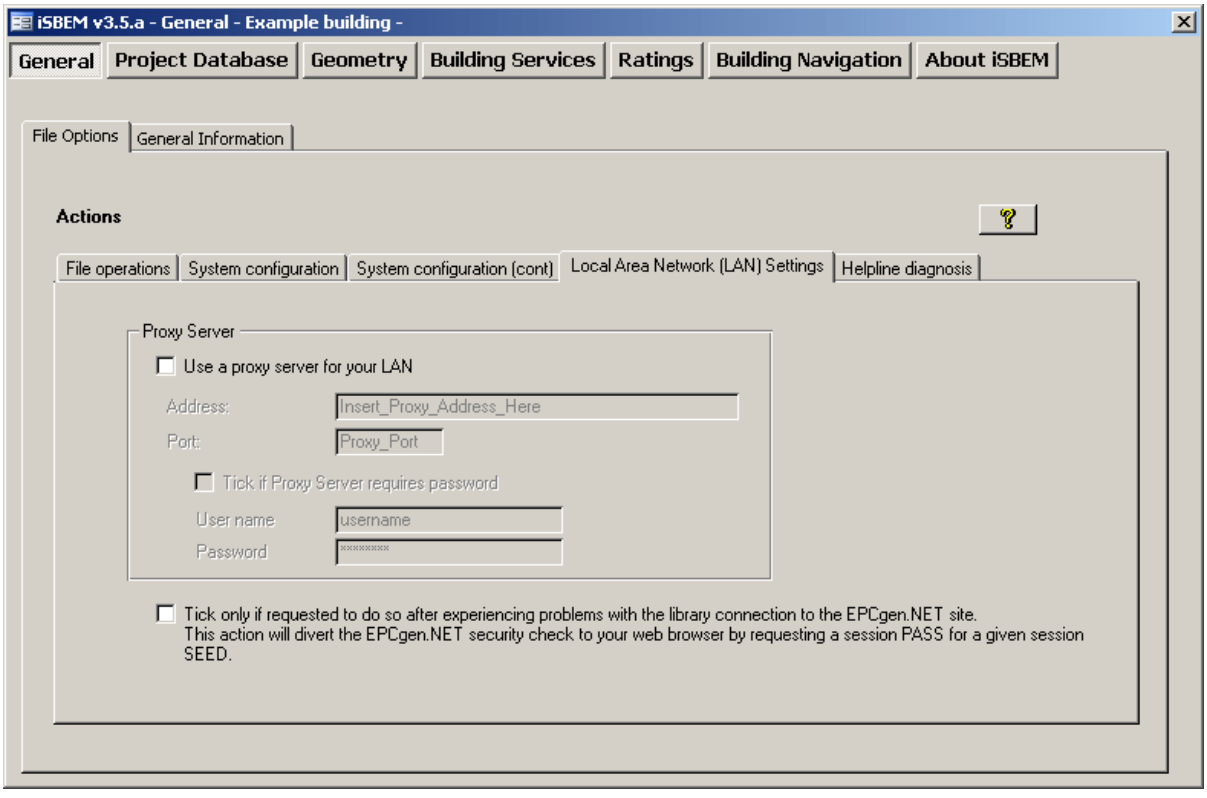


Figure 21: The Local Area Network (LAN) Settings sub-tab

Helpline Diagnosis sub-tab:

In this sub-tab (Figure 22), there is a button that initiates the generation of diagnosis data for the SBEM Helpline to assist in identifying a problem. This button should not be pressed unless you are requested to do so by the SBEM Helpline.

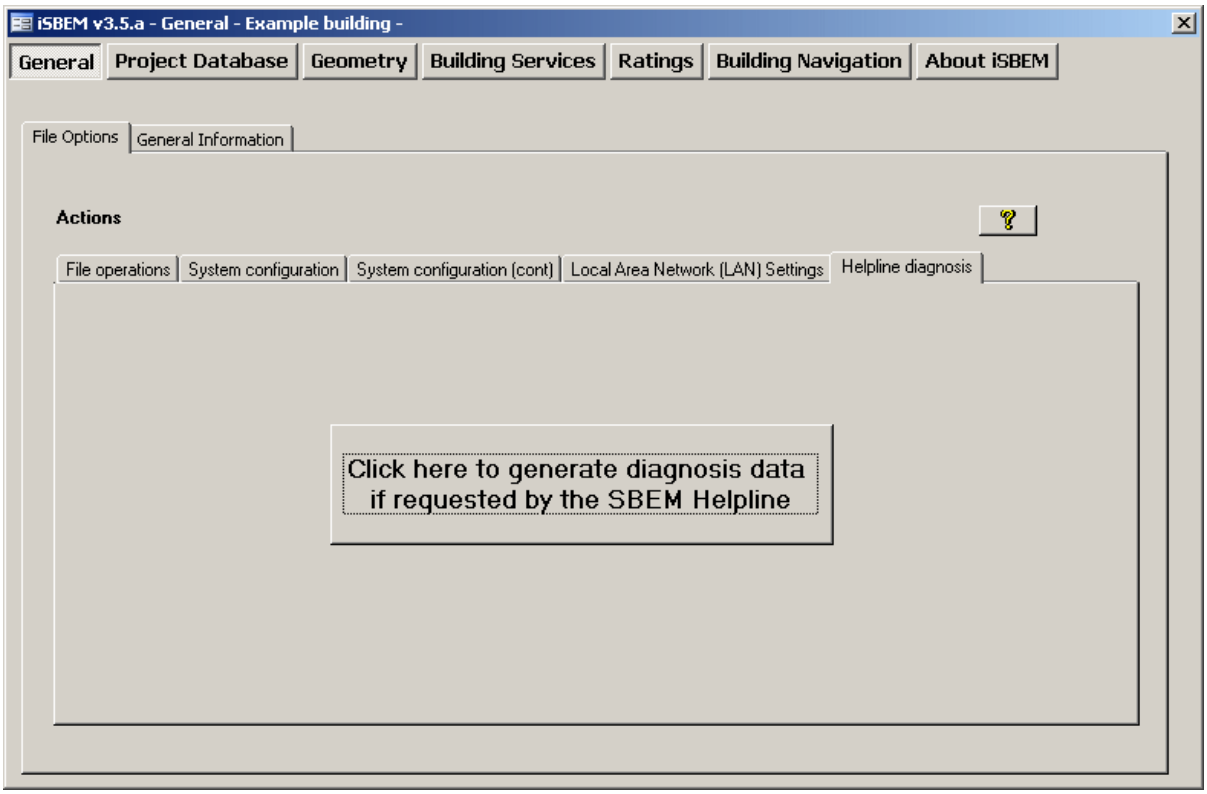


Figure 22: Helpline Diagnosis sub-tab

7.3.2. General Information tab

The *General Information* tab contains four sub-tabs, as described below, where you can enter as much or as little background information about the project. However, there are also essential parameters to be selected, such as the weather location for the project and the purpose of the analysis. These details can be entered and edited in their respective tabs (see Figure 23). Some of this information may have already been entered when the project was first created (see Section 4.4, under 'Create a new project').

The *General Information* tab contains four sub-tabs:

- **Project Details** sub-tab.
- **Building Details** sub-tab.
- **Certifier Details** OR **Energy Assessor Details** OR **Agent Details** OR **Qualified/Accredited Person** sub-tab.
- **Owner Details** sub-tab.

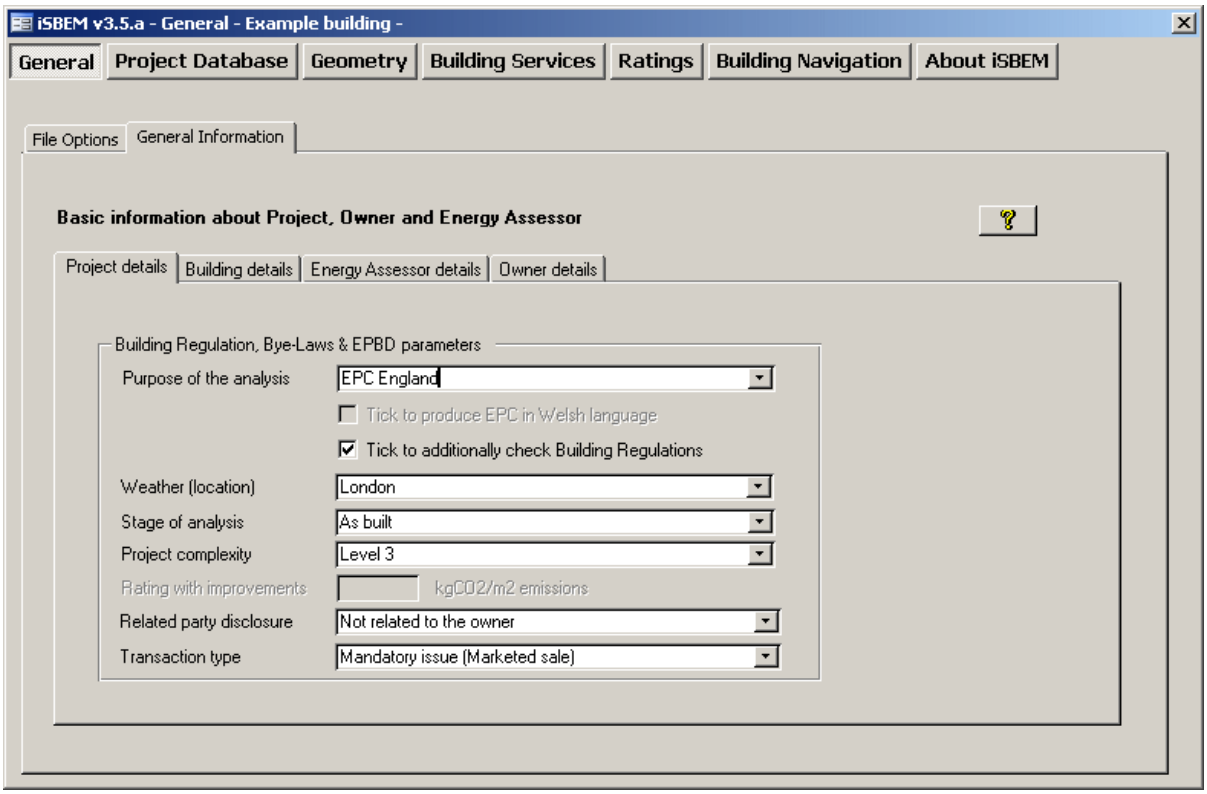


Figure 23: The General Information tab in the General form

Project Details sub-tab:

In this sub-tab, the following information can be entered (Figure 23):

Building Regulations & EPBD Parameters

1. Purpose of the analysis – purpose for carrying out a calculation using SBEM, whether it is to check compliance with Building Regulations or to generate an Energy Performance Certificate., e.g., England & Wales Building Regulations Part L.

NB: If either 'England and Wales Building Regulations Part L', 'Scottish Building Regulations', or 'Northern Ireland Building Regulations Part F' is selected as the "Purpose of Analysis", then the *Building Regulation Check* tab becomes visible in the *Ratings* form to enable running SBEM for compliance checking with Building Regulations. If 'EPC England', 'EPC Wales', 'EPC Scotland', or 'EPC Northern Ireland' is selected as the "Purpose of Analysis", then the *Asset Rating* tab becomes visible instead in the *Ratings* form to enable running SBEM for the generation of Energy Performance Certificates.

2. Tick box to indicate whether you wish to produce the EPC in Welsh as well as in English – This parameter is active only if the "Purpose of Analysis" parameter is set to 'EPC Wales'.
3. Tick box to indicate whether, in addition to producing an EPC, you wish to check compliance with Building Regulations and produce a compliance document – This parameter is active only if the "Purpose of Analysis" parameter is set to 'EPC England', 'EPC Wales', 'EPC Scotland', or 'EPC Northern Ireland'.
4. Weather location (pick the closest to your site from the available locations – there are 14 locations for England and Wales, 1 for Scotland, and 1 for Northern Ireland.
5. Stage of analysis – whether "as designed" or "as built". This parameter is not enabled if the Scottish Regulations are selected in the "Purpose of the Analysis" parameter above. Also, only the option "as built" is available when the purpose of analysis is generating EPCs.

6. Project complexity – complexity of the building for the purposes of energy assessments for EPCs. This parameter is active only if the "Purpose of Analysis" parameter is set to 'EPC England', 'EPC Wales', or 'EPC Northern Ireland'. The options available are:

    - 'Level 3' – simple, existing buildings that can be modelled using SBEM, e.g., small buildings such as converted houses or doctors' surgeries.
    - 'Level 4' – new and existing buildings that can be modelled using SBEM, e.g., small purpose built office buildings.
    - 'Level 5' – new and existing complex buildings that need to be modelled using Dynamic Simulation Models (DSMs), e.g., large office buildings or factories.

Further guidance

The decision of which level of assessor should be assigned to a particular building should follow the agreed convention flow chart in APPENDIX G:.

NB: If in doubt about whether iSBEM would be appropriate for modelling your building, please contact your Accreditation Scheme Provider.

7. S6 type of building – type of building according to Section 6 of the Scottish Building Regulations, i.e., this parameter is active only if the Scottish Building Regulations are selected in the "Purpose of the Analysis" parameter above.

8. Tick box to indicate if the building is fully naturally ventilated and separate calculations have confirmed that it will not overheat without the need for any mechanical ventilation – This parameter is active only if the "Purpose of Analysis" parameter is set to 'Scottish Building Regulations', and if ticked (justifications provided to Building Control), a 5% credit is applied by SBEM to the heating demand of naturally ventilated zones in the building, as specified in Section 6.

Further guidance

9. Rating with improvements – the potential Asset (EPC) Rating of the building, in $kgCO_2/m^2$, if the recommended energy performance improvements were implemented. This parameter is active only if the Scottish Building Regulations are selected in the "Purpose of the Analysis" parameter above.

    NB: SBEM does not calculate the potential improved rating with recommendations. This value is input by the user. If the Energy Assessor does not want a question mark to appear in the Ratings form and the EPC, the improved rating value needs to be entered by the Energy Assessor. The Energy Assessors can use iSBEM to arrive at that rating value by making a copy of the original completed nct file containing the building model in iSBEM in which they can implement their selected recommendations (out of the Recommendations report - whether NCM or added by the Energy Assessor), run the calculation, and obtain the potential improved rating. They can then input that same value in the original nct file of the building (as described above) and re-run the calculation for the value to appear on the original EPC for Scotland.

10. Related party disclosure – any related party disclosure by the Energy Assessor for the purposes of energy calculations for EPCs. This parameter is active only if the "Purpose of Analysis" parameter is set to 'EPC England', 'EPC Wales', or 'EPC Northern Ireland'. **NB:** The input for this parameter is now done through a drop-down menu rather than free text, and a valid option must be selected for the EPC calculation to run successfully.

NEW

NEW

11. Transaction type – the transaction type which prompted the generation of the EPC. This parameter is active only if the "Purpose of Analysis" parameter is set to 'EPC England', 'EPC Wales', or 'EPC Northern Ireland'. A valid option for this parameter must be selected from the drop-down menu for the EPC calculation to run successfully.

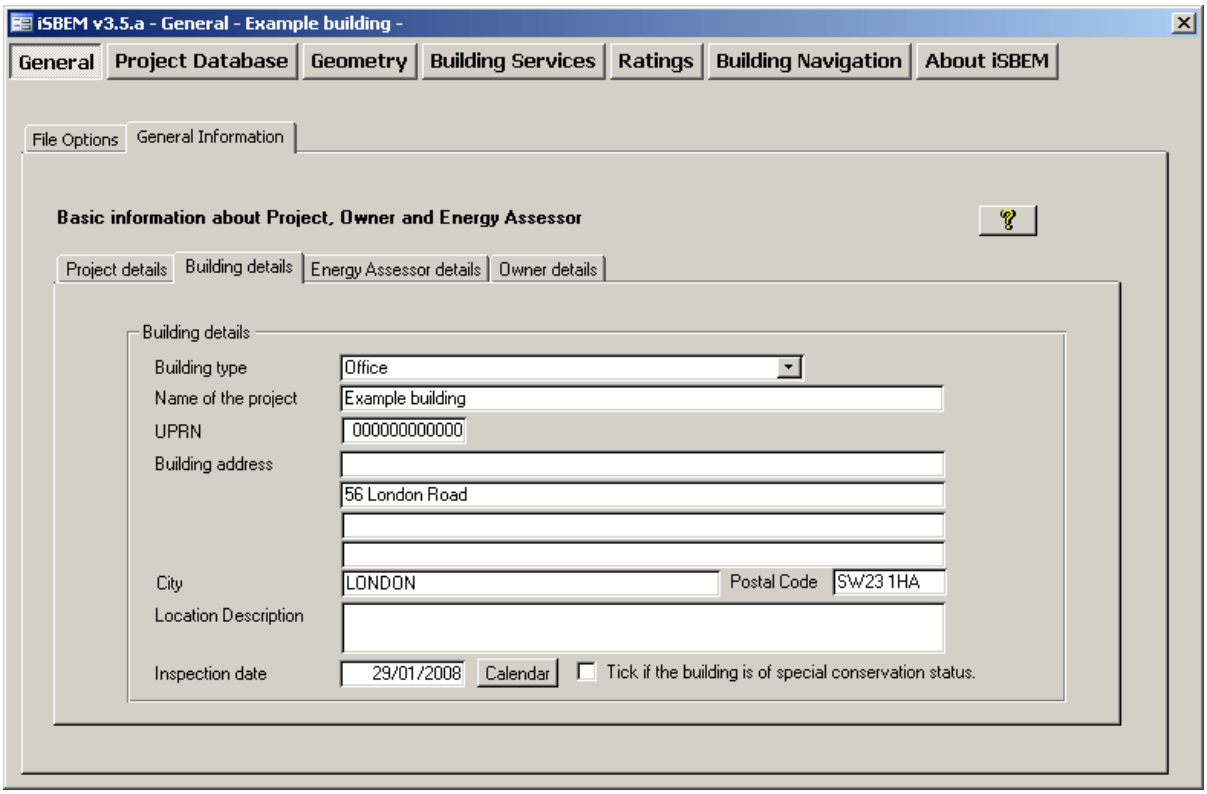


Figure 24: The Building Details sub-tab of the General Information tab in the General form

Building Details sub-tab:

In this sub-tab (Figure 24), the following information can be entered:

Building Details

1. Building type - The choice of building type here sets the default building type for the activity areas that you will define later. You will, however, be able to change the building type for each of the activity areas when you come to define them. At this point, you should choose the building type that most closely defines the majority of the building.
2. Name of the project. **NB:** The text input in this field should not include any double quotes.
3. UPRN - the Unique Property Reference Number (UPRN) of the building. This parameter is active only if the “Purpose of Analysis” parameter is set to ‘EPC England’, ‘EPC Wales’, or ‘EPC Northern Ireland’. This parameter must consist of 12 digits and should not be left blank.
4. Building address. **NB:** The text input in this field should not include any double quotes.
5. City. **NB:** The text input in this field should not include any double quotes.
6. Post Code. **NB:** The text input in this field should not include any double quotes.
7. Location description - a description of the building location. **NB:** The text input in this field should not include any double quotes.
8. Inspection Date – the date on which the energy assessor inspected the building for the purposes of energy calculations for EPCs. This parameter is active only if the “Purpose of Analysis” parameter is set to ‘EPC England’, ‘EPC Wales’, or ‘EPC Northern Ireland’.
9. Tick box to indicate whether the building has a special conservation status (i.e., the building has been identified as being: one of special architectural or historical interest, in a conservation area, in a designated area of special character or appearance, or of traditional construction) - This parameter is active only if the “Purpose of Analysis” parameter is set to ‘EPC England’, ‘EPC Wales’, or ‘EPC Northern Ireland’.

Certifier Details / Energy Assessor Details / Agent Details / Qualified/Accredited Person Details sub-tab:

The name of this sub-tab changes depending on the option selected in the parameter "Purpose of Analysis" in the *Projects Details* sub-tab, as follows:

- **Certifier Details** sub-tab – if the option selected is 'England and Wales Building Regulations Part L' or 'Northern Ireland Building Regulations Part F'.
- **Energy Assessor Details** sub-tab – if the option selected is 'EPC England', 'EPC Wales', or 'EPC Northern Ireland'.
- **Agent Details** sub-tab – if the option selected is 'Scottish Building Regulations'.
- **Qualified/Accredited Person Details** sub-tab – if the option selected is 'EPC Scotland'.

This sub-tab (Figure 25) contains two sub-forms: *Energy Assessor Details* sub-form and *Insurance Details* sub-form.

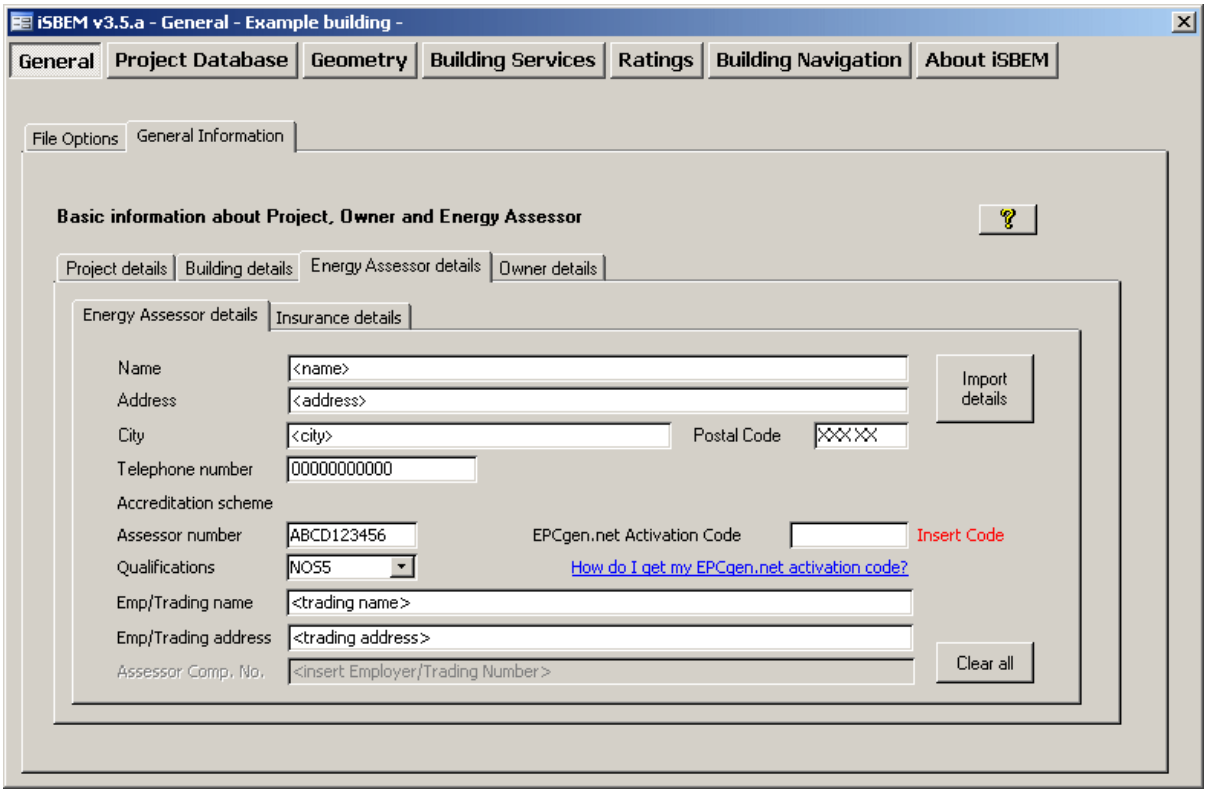


Figure 25: The Energy Assessor Details in the General form

Energy Assessor Details sub-form: in this sub-form, the following information can be entered:

1. Name – of the certifier, energy assessor, agent, or qualified/accredited person. **NB:** The text input in this field should not include any double quotes.
2. Address – of the certifier, energy assessor, agent, or qualified/accredited person. **NB:** The text input in this field should not include any double quotes.
3. City – of the certifier, energy assessor, agent, or qualified/accredited person. **NB:** The text input in this field should not include any double quotes.
4. Post Code – of the certifier, energy assessor, agent, or qualified/accredited person. **NB:** The text input in this field should not include any double quotes.
5. Telephone number – of the certifier, energy assessor, agent, or qualified/accredited person.

6. Accreditation Scheme – the accreditation scheme of the energy assessor becomes visible in the interface after the user enters the Assessor Number (the parameter below), for EPC Calculations in England, Wales, and Northern Ireland. The name of the Accreditation Scheme will correspond to the Assessor Number provided.
7. Assessor number – the registration number of the energy assessor. This parameter is active only if the "Purpose of Analysis" parameter is set to 'EPC England', 'EPC Wales', or 'EPC Northern Ireland'. This parameter must consist of 4 capital letters followed by 6 digits, and it should not be left blank.
8. Qualifications – the qualifications of the energy assessor as they will need to be qualified for the type of building being assessed (check with your accreditation scheme). This parameter is active only if the "Purpose of Analysis" parameter is set to 'EPC England', 'EPC Wales', or 'EPC Northern Ireland'. See the "Project complexity" parameter in the *General Information* tab.
9. Emp/Trading Name – the employer or the trading name of the energy assessor. This parameter is active only if the "Purpose of Analysis" parameter is set to 'EPC England', 'EPC Wales', or 'EPC Northern Ireland'. NB: The text input in this field should not include any double quotes.
10. Emp/Trading Address – the employer or the trading address of the energy assessor. This parameter is active only if the "Purpose of Analysis" parameter is set to 'EPC England', 'EPC Wales', or 'EPC Northern Ireland'. NB: The text input in this field should not include any double quotes.
11. EPCgen.net Activation Code – the energy assessor's Activation Code received from EPCgen.net. This parameter is active only if the "Purpose of Analysis" parameter is set to 'EPC England', 'EPC Wales', or 'EPC Northern Ireland', and your accreditation scheme allows generation of final EPC documents directly on your local computer. See the "Project complexity" parameter in the *General Information* tab.

NB: When you run the EPC calculation for the first time while your computer is connected to the internet (i.e., click on the "Calculate EPC Rating" button in the *Ratings* form), an email containing your Activation Code will be sent to the email address registered for you as an Accredited Energy Assessor in the National Register (at www.epcregister.com). You need to copy the Activation Code from the email and paste it into the allocated field exactly as it appears in the email. This only applies to assessors accredited by an Accreditation Scheme Provider that allows Energy Assessors to generate the final EPC documents for lodgement through the Energy Assessors' computers.

NB: If you do no receive the email with the Activation Code (this is an automatic process and should not take longer than a couple of minutes) even though your computer is connected to the internet, you have entered the proxy server details correctly, if applicable, and you have run the EPC calculation successfully, you need to contact your Accreditation Scheme Provider and ensure that the email address registered for you with your details on the National Register is correct and valid. You should also ensure that the settings in your email account have not flagged up the Activation Code email as "junk" and discarded it to the "Delete bin".

Further guidance

NB: See APPENDIX E: Activation codes and connection to EPCgen.net, for more guidance.

NB: (For assessors accredited by an Accreditation Scheme Provider that allows Energy Assessors to generate the final EPC documents for lodgement through the Energy Assessors' computers). Please note that in order to generate the XML message for official lodgement and remove the watermark from the EPC and the Recommendations Report, your computer **must** be connected to the internet, and you need to have entered your "Energy Assessor EPCgen.net Activation Code". If there is no internet connection and/or the Activation Code has not been entered, then the XML message will not be generated and the output files produced will contain the watermark. However, this does not apply if 'EPC Scotland' has been selected as the "Purpose of Analysis".

NB: (For assessors accredited by an Accreditation Scheme Provider that generates the final EPC documents for lodgement in a central system for the Accreditation Scheme). Please note that in order to generate the IAS file required by the Accreditation Scheme Provider, your computer **must** be connected to the internet. If there is no internet connection, then the IAS file will not be generated. The output files produced on your computer will always contain the watermark.

12. Membership Number – the membership number of the qualified/accredited person. This parameter is active only if the "Purpose of Analysis" parameter is set to 'EPC Scotland'.
13. Protocol Organisation – the accreditation scheme of the qualified/accredited person. This parameter is active only if the "Purpose of Analysis" parameter is set to 'EPC Scotland'.

Import Details – clicking on this button will enable you to import the assessor details which you might have entered in a previous version of iSBEM, instead of re-typing them. After you click, you will have the option to browse the folders on your computer and select a previous version of iSBEM, for e.g., iSBEM_v3.3.b.mdb, from which to import the previously input details into the version of iSBEM you are working with.

NB: All the information in the *Certifier Details / Energy Assessor Details / Agent Details / Qualified/Accredited Person Details* sub-tab will remain visible in any new project created but can be cleared by pressing the "Clear all" button.

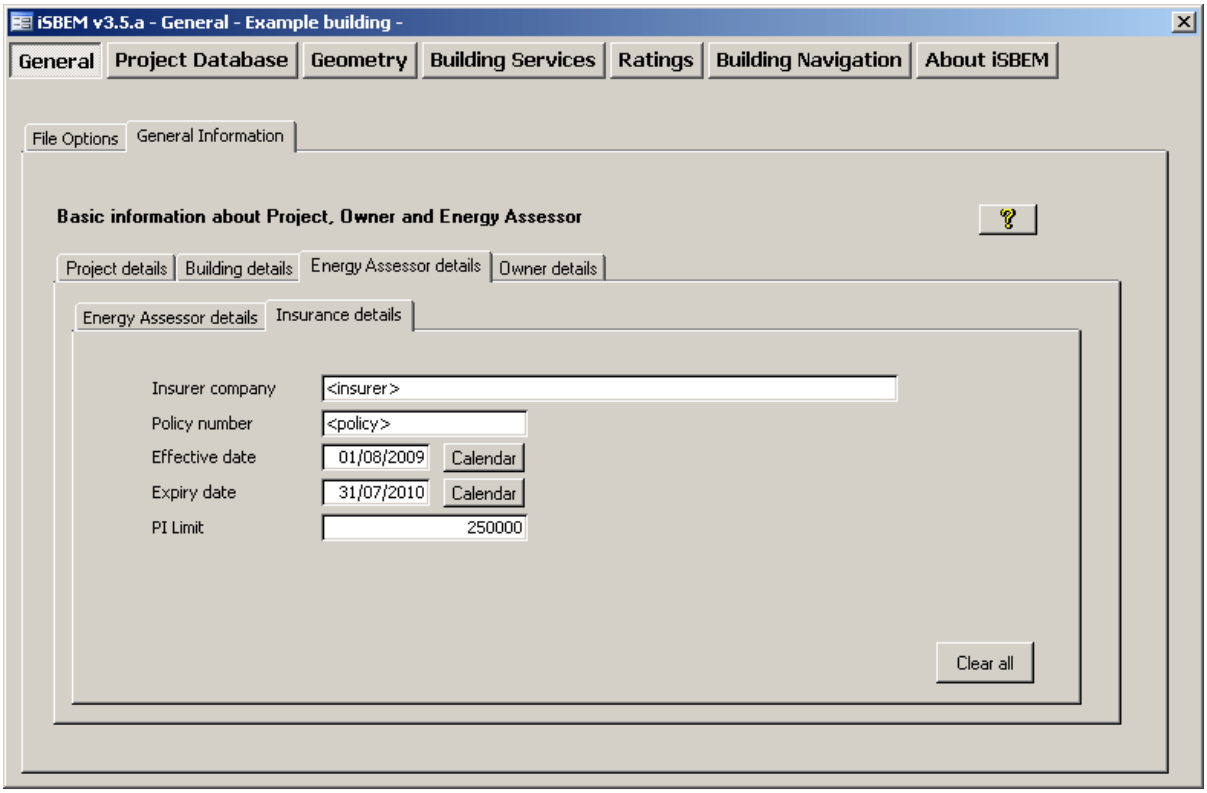


Figure 26: Insurance Details in the General form

Insurance Details sub-form: This sub-form is available only if the "Purpose of Analysis" parameter is set to 'EPC England', 'EPC Wales', or 'EPC Northern Ireland'. This is where the following information can be entered:

1. Insurer Company – Name of the energy assessor's insurance company. **NB:** The text input in this field should not include any double quotes.
2. Policy Number – The energy assessor's insurance policy number.

3. Effective Date – The energy assessor's insurance policy effective start date.
4. Expiry Date – The energy assessor's insurance policy expiry date.
5. PI Limit – The energy assessor's insurance policy cover limit.

Further guidance

Owner Details sub-tab (*Previously* Occupier Details sub-tab):

In this sub-tab (Figure 27), the following information can be entered:

Owner of the Building Details

1. Name – of the owner of the building. **NB:** The text input in this field should not include any double quotes.
2. Telephone number – of the owner of the building.
3. Address – of the owner of the building. **NB:** The text input in this field should not include any double quotes.
4. City – of the owner of the building.
5. Post Code – of the owner of the building.

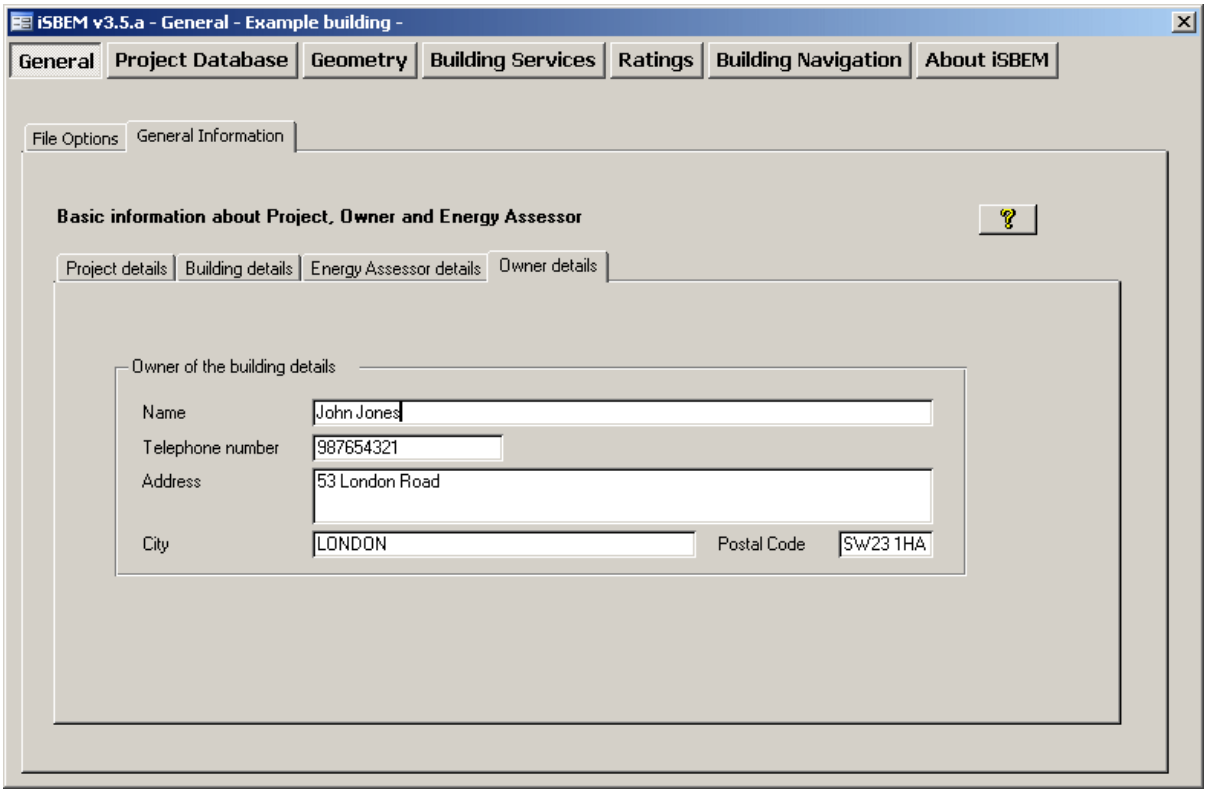


Figure 27: The Owner Details sub-tab of the General Information tab in the General form

NB: The background information has already been entered for the Example building so there is no tutorial task relating to the *General* form.

7.4. Project Database form

Each type of construction used in the building fabric is defined within the *Project Database* form. Within this form, there are five main tabs (circled in Figure 28):

- **Constructions for Walls** tab
- **Constructions for Roofs** tab
- **Constructions for Floors** tab
- **Constructions for Doors** tab
- **Glazing** tab

In each tab, you need to enter information on each of the different types of construction found in the building. For example, in your building, there may be two glazing types. This is where you enter the details of these types. Later on, during the building's geometry definition, each of these construction/glazing types can be assigned to particular parts of the building envelope/door/window. In other words, you are not defining the walls, doors, or windows of your building at this stage; just the characteristics of the materials used in their construction.

Clicking on the "Check Objects assignment" button produces two reports: the *Unassigned Objects* Report and the *Data Summary* Report. These reports can be used to check the data entered at any stage of inputting a building into the interface. There is a "Reports" button on each tab within the interface so it is not necessary to return to this form to access the reports. How to double-check the data you have entered is explained at the end of this chapter (see Section 7.9: Double-checking the data).

Notes:

- Constructions for intermediate floors/ceilings are dealt with under the *Constructions for Floors* tab.
- If the space in the roof is unconditioned, the top floor ceiling should be dealt with as a "roof". It should be given the combined thermal performance of the whole construction including the ceiling construction, the void, and the roof construction.
- Only constructions for external doors and windows need to be defined in iSBEM (i.e., ignore internal doors and windows).

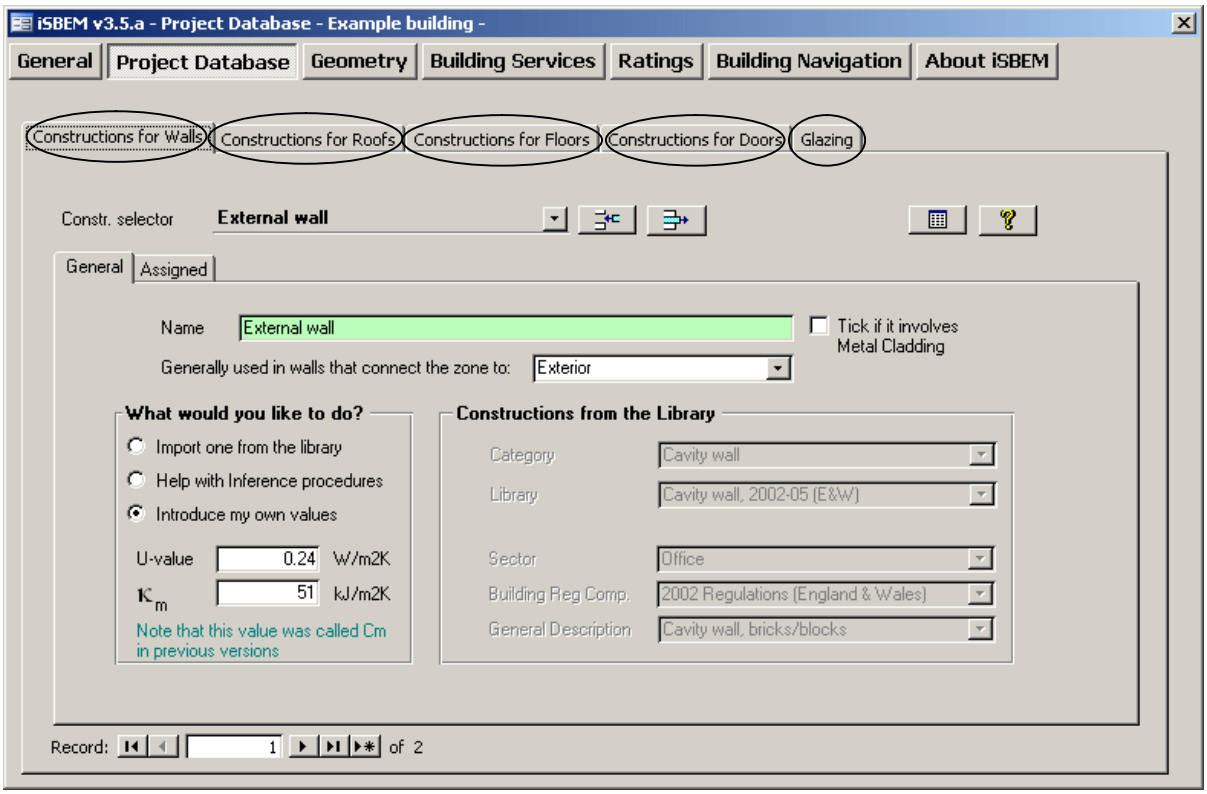


Figure 28: The Constructions and Glazing tabs in the Project Database form

Each of the main tabs in the *Project Database* form has two sub-tabs: *General* and *Assigned*. The *General* tab is where the information is entered to define your construction types - see the following section on how this is done. The *Assigned* tab contains a list of all the envelope elements (doors or windows) of the building to which this construction (or glazing) has been "assigned". You cannot edit the list on this screen as it is provided for viewing only (see Figure 29).

NB: At this stage in the tutorial, most of the *Assigned* tabs will be blank as you will not have yet created the building elements to which these constructions need to be assigned. You will do this in Section 7.5: Geometry form.

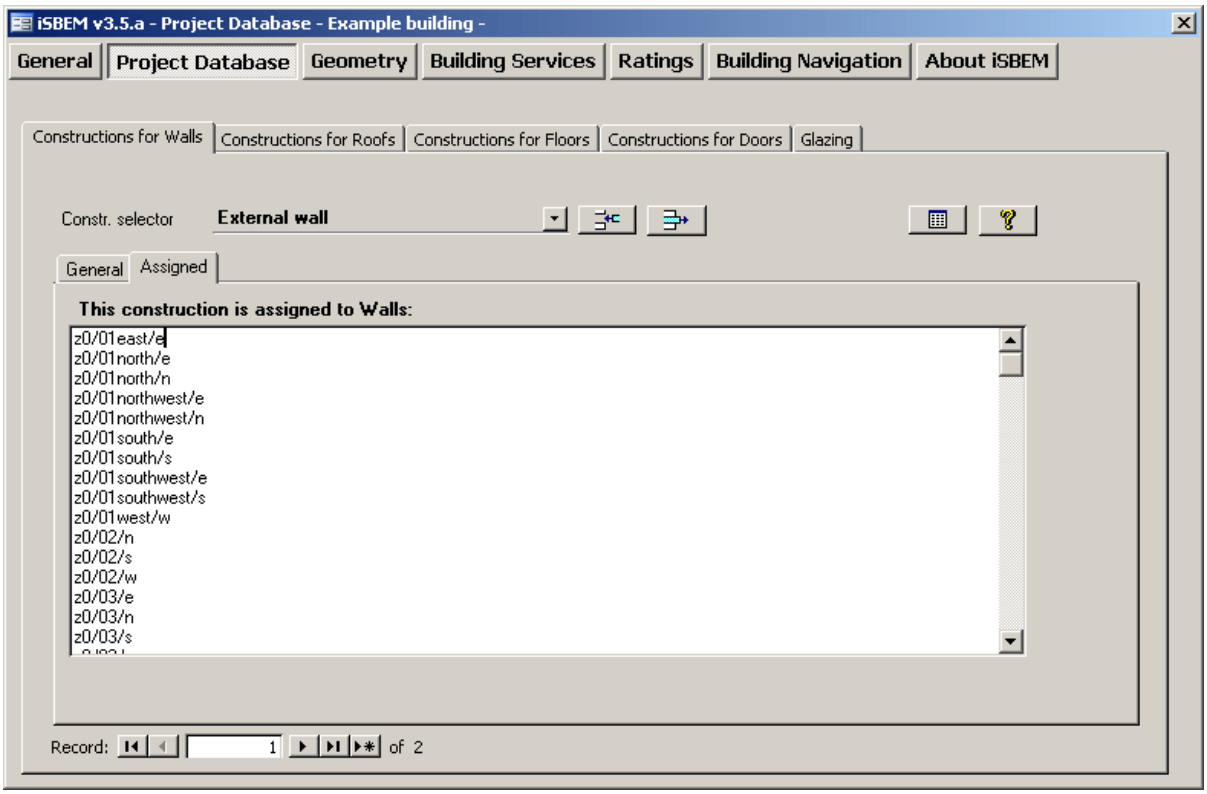


Figure 29: The Assigned sub-tab in the Constructions for Walls tab

7.4.1. Defining construction types

To insert a new type of construction, you must firstly create a new record by clicking on the "Create a new record" button shown in Figure 30. For each new construction, you need to enter the following information:

1. Name - You will be prompted to enter a unique name for your construction (this must be done before you can continue with the construction's definition).
2. Generally used in walls/floors/roofs which connect zones to (for walls, roofs, and floors only) – Here you need to select from the options in the drop-down menu (see Figure 30), which include the options of: Exterior, Strongly ventilated space, Unheated adjoining space, Conditioned adjoining space, and Underground. This sets the default or 'global' condition of the adjacent space which will appear when you assign this construction for a specific envelope element (see Section 7.5.4: Defining envelope, for details on how this global value is used). This parameter is only required for walls, roofs, and floors.
3. Tick if the construction involves metal cladding (for walls and roofs only) – tick box.

   NB: Constructions involving metal cladding are roof or wall systems where metal forms an integral part of the construction, such as metal twin skin systems where the insulation is located between the metal skins and where the metal skins are typically 0.4 mm to 1.2 mm thick. Metal cladding systems are divided into two broad categories: (a) built-up metal cladding systems involving rail and bracket or z-spacer systems with insulation within the panels, and (b) composite-panel metal cladding systems with insulation inside the panels. If the metal is simply used as an external shield against the weather, such as a rainscreen, this is not, for the purposes of SBEM calculations, considered as "metal cladding".
4. Description of the construction - SBEM requires a number of parameters to describe the thermal characteristics of the construction types. These can be introduced into iSBEM in one of three ways:

i. Import directly from the library - This is the default option. If it is not already selected, you need to click on the "Import one from the library" radio button. Then, in the library drop-down menu(s), choose the construction that most closely matches the one you are trying to define, from your knowledge of what has been found in the building or is specified on drawings or schedules.

ii. Choose from the library following inference procedures - This option is intended for use when certifying existing buildings, when you may not have the drawings or schedules which specify the construction types used in the building. The inference procedures will help you to select construction types on the basis of non-technical information you may have on the building. To use this option, you need to click on the "Help with Inference procedures" radio button and then in the inference drop-down menus, choose the options that most closely describe your construction. For example, for a wall, you may be able to choose a construction based on the sector, the building regulations year with which you think it would be compliant, and a general description.

iii. Manually introduce the values - Click on the "Introduce my own values" radio button if you wish to enter your own values to define the construction.

For **walls, roofs, floors, and doors***,* there are two parameters which need to be entered: the U-value (W/m^{2}K) and the κ_m value (renamed from C_m value) (kJ/m^{2}K). (See below for the description of these parameters). <u>If the user selects a construction type from the construction library or through the inference procedures, these values are imported automatically from the iSBEM databases.</u>

For **glazing** types, the parameters that need to be entered manually are: the U-value, the solar transmittance (T-Solar), and the light transmittance (L-Solar). (See below for the description of these parameters). <u>If the user selects a glazing type from the glazing library or through the inference procedures, these values are imported automatically from the iSBEM databases.</u>

NB: Remember that the values chosen may have to be justified to the Building Control officers to gain Building Regulations approval.

NB: <u>Glazed Doors</u> - Doors which are more than 50% glazed should be entered into iSBEM as windows, and their light and solar characteristics should be entered into the *Project Database* form > *Glazing* tab. Doors which are 50% or less glazed can be treated as opaque doors.

U-Value

The U-value is the thermal transmittance of the construction, given in W/m^{2}K. It can be calculated using the "combined method" given in BS EN ISO 6946 for simple constructions. Constructions such as cladding and steel frame constructions require more complicated calculation procedures, and an appropriate methodology should be followed. For example, the "BRE U-value Calculator" would be appropriate for these construction types. (Guidance on the calculation of U-values for curtain walls can be found in 'The Thermal Assessment of Window Assemblies, Curtain Walling and Non-traditional Building Envelopes', *Ledbetter, S., et al.*, Centre for Window and Cladding Technology, University of Bath, Bath, March 2006).

NB: In the case of a user-defined U-value for ground floors, the user needs to specify (using a tick-box) whether the U-value entered into iSBEM has been obtained following the guidance specified in section 3.5.2 of "CIBSE Guide - Vol. A - 2007" (and "BR 443:2006 - Conventions for U-value Calculations"), i.e., the U-value has been modified/corrected to account for insulation to counter the heat loss through floors in contact with the ground. If the U-value input by the user has already been modified, then SBEM will use the U-value as it is. Otherwise, SBEM will make the modification (as a function of the ratio of exposed perimeter to floor area and the thermal resistance of the floor construction), which is always the case when the floor construction is selected from the Library or using Inference procedures.

NB: The calculation of the U-values of rooflight/window systems must include the effect of the bars that form part of the glazing system.
NB: The glazing U-value entered should be for glazing in a vertical inclination. This value is adjusted in SBEM to produce the correct U-value for the window/rooflight inclination (the correction for a horizontal flat roofs is +0.3 to the U-value and for pitched roofs, it is +0.2 to the U-value). However, the value checked for compliance with building regulations is the one input and not the adjusted U-value used within the calculation.

k_m (Kappa m) value

The κ_m value (renamed from C_m value) is the effective thermal capacity of an element (wall, floor, ceiling, etc), given in kJ/m^{2}K. As it takes some time for heat to flow into or out of the building fabric, not all the thermal capacity is useful. The κ_m value represents that part which affects the heating and cooling energy demands. The rules for calculating it can be found in the CEN standard: prEN 13790:2006. In brief, *for each construction element*: Calculate the contribution of each layer of construction by calculating: density (kg/m^3) x thickness (m) x specific heat capacity (kJ/(kgK)). Starting from the layer of the construction closest to the space (i.e., from the interior), add these values together until any one of the following conditions is satisfied:

- the sum of the layers thicknesses has reached 0.1 m,
- you have reached the mid-point of the construction, or
- you have reached an insulating layer (defined, for SBEM purposes, as having a conductivity of 0.08 W/mK or less).

NB: If the construction contains an air cavity whose conductivity is above 0.08 W/mK, the contribution of the air cavity needs to be taken into account in the calculation of the κ_m value (although the contribution to the thermal mass of the construction would be very small), i.e., it is not considered as an insulating layer.

T Solar
T Solar is the total solar energy transmittance (*g perp*) defined as the time-averaged ratio of energy passing through the un-shaded element to that incident upon it. T Solar values entered by the user should refer to values for normal incidence of solar radiation. **NB:** External movable devices for solar protection are accounted for later when defining the window in the *Geometry* form, through the shading system options.

L Solar
L Solar (light transmittance) is the amount of visible solar energy that passes through a glazing system, expressed as a fraction of the visible solar energy incident on it. This value will be used for the daylighting calculations. L Solar values entered by the user should refer to values for normal incidence of solar radiation.

NB: Total solar energy transmittance values given by windows manufacturers are usually given for solar radiation perpendicular (normal) to the glazing (*g perp*). However, SBEM uses monthly calculations and therefore, a value (*g*) averaged over all angles of incidence. Accepting some simplifications, SBEM calculates this value by multiplying (*g perp*) by a factor of 0.9. This also applies to the light transmittance values.

NB: In the Glazing Database, "Uncoated, clear" refers to ordinary clear glass which has no low-emissivity coating and no tint, "Reflectance, low-emissivity" refers to glazing in which at least one glass pane has a low-emissivity coating (such as "Pilkington K" glass or "Optitherm" glass), and "Tinted" refers to glazing where at least one pane is colour-tinted.

NB: For windows or other glazed envelope elements with non-scattering glazing, ISO 9050 and EN410 provide a method to obtain the solar energy transmittance for radiation perpendicular to the glazing. EN 13363-2 and ISO 15099 provide methods of determination of the total solar

energy transmittance of glazing equipped with solar protection devices. For more information, see also section 11.4 of the CEN Standard prEN wi 14.

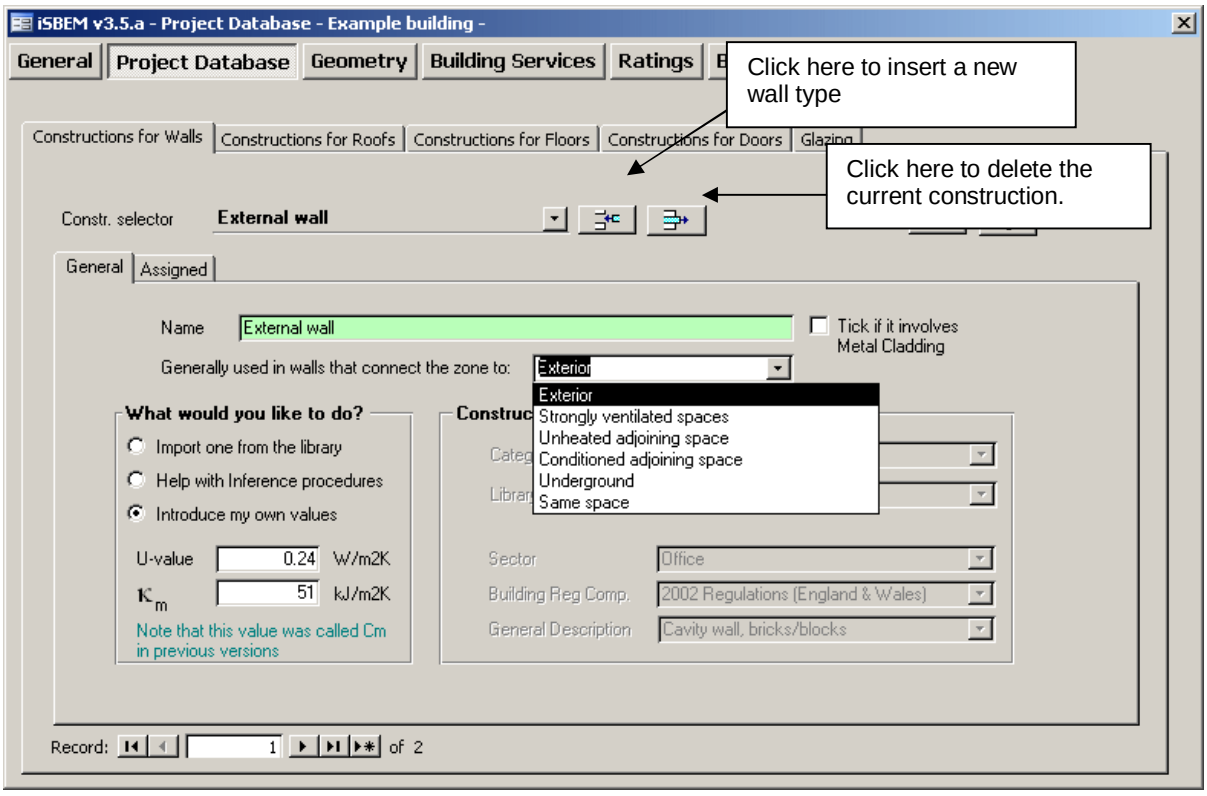


Figure 30: An external wall being defined in the Constructions for Walls tab

Task 4: Define each of the construction types

Fabric details for the Example building are listed in APPENDIX A:, Section A.1: Constructions. Look through the records in each of the sub-tabs using the record selector, and you will see that five out of the seven constructions have been defined for you. You need to define the roof and the internal wall constructions. This will involve clicking on the appropriate sub-tab, adding a new record, clicking on the appropriate radio button, and choosing the appropriate options from the drop-down menus.

As you will see, the glazing, door, and external wall parameters have been entered manually, the ground floor has been entered using the inference procedures, and the internal floor has been selected from the library. The roof and internal walls can both be selected from the library. Simple names such as “Ground floor for Example building” have been used.

Viewing and deleting construction types

To view the construction types that you have in your *Project Database* form, you need to click on the record selector[iv] in each of the four tabs. A drop-down list will then appear showing all of the constructions that have been defined in that project so far. To delete a construction or glazing type, you need to select it using the record selector, and then click on the “Delete record” button.

[iv] For further descriptions of the various commands in iSBEM, see Chapter 6: BASIC iSBEM FUNCTIONALITY AND THE HELP MENU.

7.5. Geometry form

Depending on what information you have first, you can start by entering information into either the *Geometry* form or the *Building Services* form.

To define the geometry of your own building, you will need to have followed the instructions on "zoning" given in Chapter 3. (The Example building has been "zoned" for you. Details can be found in Table 17, Figure 95: Ground floor plan, and Figure 96: First floor plan in APPENDIX A:.)

The *Geometry* form contains five main tabs (see Figure 31):

- **Project** tab – This tab requires geometrical information on the whole building rather than on a zone level and is where you can enter global default values for a number of parameters to be used.

The geometry of **each zone** is then described in the following four tabs:

- **Zones** tab
- **Envelopes** tab
- **Doors** tab
- **Windows and rooflights** tab

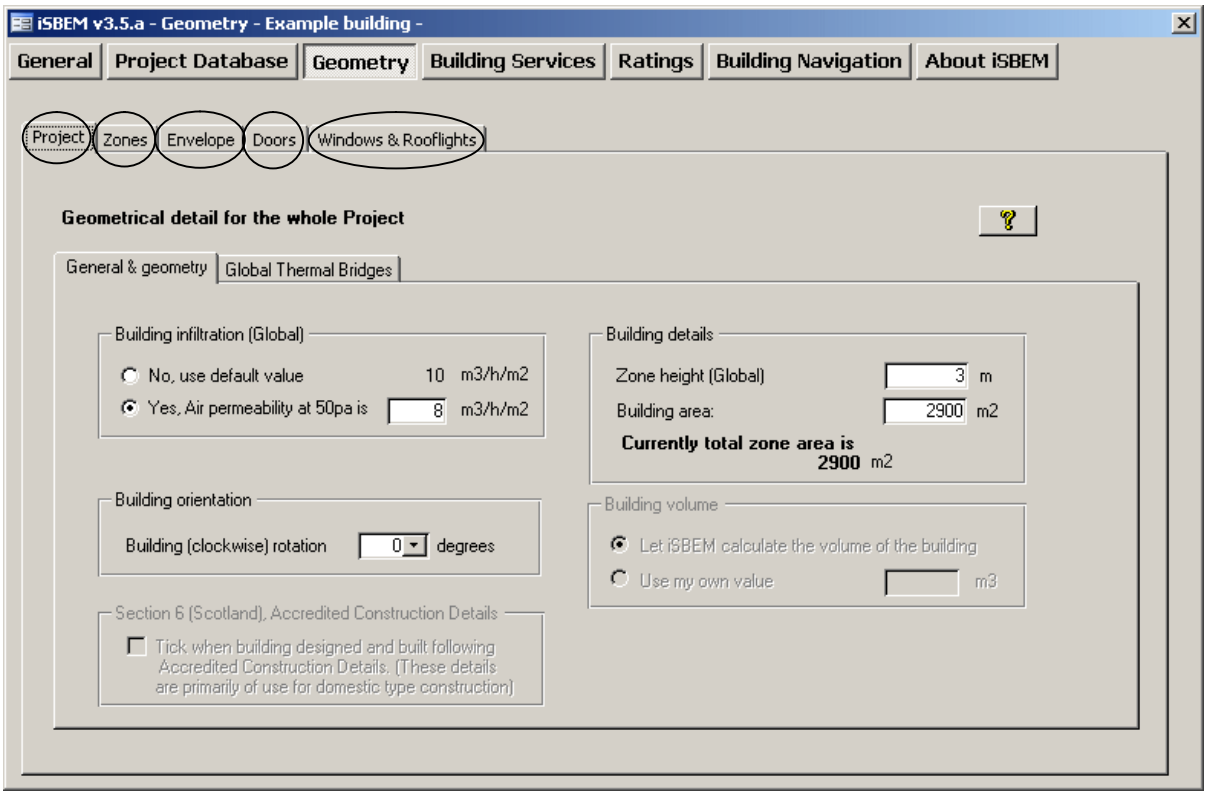

iSBEM v3.5.a - Geometry - Example building -
General
Project Database
Geometry
Building Services
Ratings
Building Navigation
About iSBEM
Project
Zones
Envelope
Doors
Windows & Rooflights
Geometrical detail for the whole Project
General & geometry
Global Thermal Bridges
Building infiltration (Global)
No, use default value 10 m3/h/m2
Yes, Air permeability at 50pa is 8 m3/h/m2
Building details
Zone height (Global) 3 m
Building area: 2900 m2
Currently total zone area is 2900 m2
Building orientation
Building (clockwise) rotation 0 degrees
Building volume
Let iSBEM calculate the volume of the building
Use my own value m3
Section 6 (Scotland), Accredited Construction Details
Tick when building designed and built following Accredited Construction Details. (These details are primarily of use for domestic type construction)

Figure 31: The Project, Zones, Envelopes, Doors, and Windows & Rooflights tabs in the Geometry form

7.5.1. Summary of how to define the geometry of a building

There are **5** steps to defining the geometry of a building:

1. **Enter building scale information** (total floor area) **and global values** which apply to most zones (such as zone height and Psi values for thermal bridges). This is done in the *Project* tab (Section 7.5.1: Project tab).

Then for **each zone**:

2. **Create the zone** - This is done in the *General* sub-tab of the *Zones* tab (Section 7.5.3: Defining zones).
3. **Create its envelope elements** – There are two ways to create envelope elements (walls, floor, and roof/ceiling):
    a. In the *Envelopes* main tab (Section 7.5.4).
    b. In the *Quick Envelopes* sub-tab of the *Zones* tab (Section 7.5.8).
4. **Create any windows** – There are two ways to do this:
    a. In the *Windows* main tab (Section 7.5.5).
    b. In the *Quick Envelope* sub-tab of the *Zones* tab at the same time as creating the envelope element it is part of (Section 7.5.8).
5. **Create any external doors** – In the *Doors* tab (Section 7.5.7).

NB: Internal windows and doors should not be entered into iSBEM.

The tabs in *italics* above are the main tabs of the *Geometry* form (see Figure 31). It is important to understand how to introduce information into these tabs (as well as being able to use the *Quick Envelope* function) as there are some parameters which can only be entered using these tabs. However, once familiar with the basis of the geometry objects, it is likely that you will enter most of your data using the *Quick Envelope* function.

Order of data entry

You need to create the zone before defining its envelope. It is not mandatory to enter all the information about the zone (envelopes, doors, windows, thermal bridges) before moving onto the next zone as you can always add or edit this information at a later time. Where possible, however, you should introduce each zone one at a time into the interface.

Description of what is happening in iSBEM

When you create a zone, envelope element, or window, you are creating what is referred to in iSBEM as a 'building object'. These building objects need to be linked together correctly in order to define the geometry of a zone. When you define an envelope element in the *Envelopes* main tab, you will be prompted to link (or assign) it to a zone. Equally, when you define a window in the *Windows & Rooflights* main tab, you are prompted to link it to an envelope element. If you create the envelope element or window in the *Quick Envelope* sub-tab, these links are established automatically. This will be further explained as you work through the Example building. The final stage of defining a zone is to assign it to the appropriate building services systems. This can be done in either the *Geometry* or *Building Services* form.

Figure 32 below is an example of a simple zone. To define the geometry of this zone, you would need to create the zone, 6 envelope elements, one window, and one door. The south wall door and window would need to be linked to the south wall, which in turn (along with the other 5 envelope elements) would need to be linked to the zone, as shown by the arrows in the diagram below.

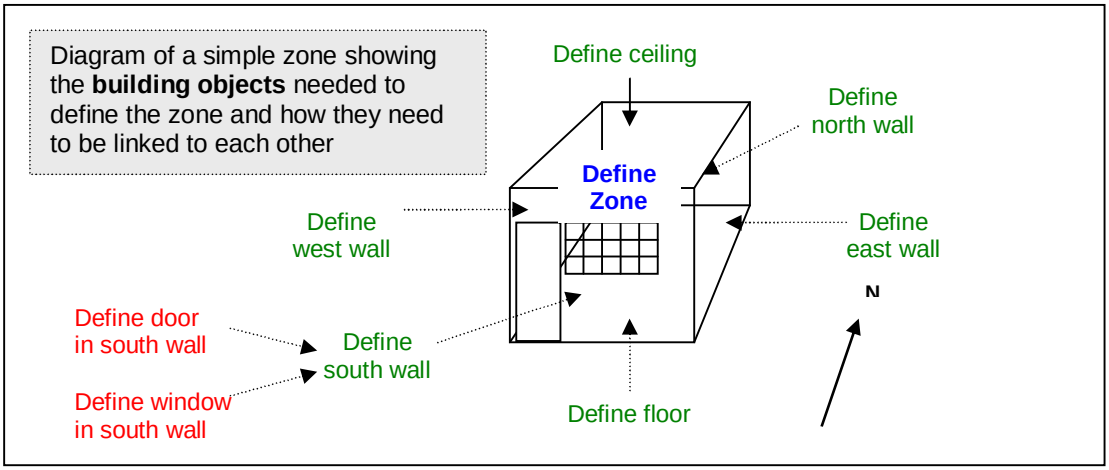


Diagram of a simple zone showing the **building objects** needed to define the zone and how they need to be linked to each other
Define ceiling
Define north wall
Define Zone
Define west wall
Define east wall
N
Define door in south wall
Define south wall
Define window in south wall
Define floor

Figure 32: Diagram of building objects needed to define a simple zone

NB: The tutorial will take you through how to define and link the building objects needed to complete the geometrical definition of a zone.

7.5.2. Project tab

Before defining the geometry of each zone, there are several parameters at the building scale which you need to enter. These include total floor area and if the building is designed and built following the guidance in Accredited Construction Details (Scotland). You can also enter global[v] values which apply to all or most zones (zone height and air permeability). These parameters are entered into two sub-tabs:

- **General & Geometry** sub-tab
- **Thermal Bridges** sub-tab

General & Geometry sub-tab:

This sub-tab requires five pieces of information as shown in Figure 34:

Building Infiltration (Global)

1. Air permeability at 50 pa ($m^3/h.m^2$) - The value you enter here will be the global or default value assigned to each zone. You can choose later to either use this global value or enter a different value for each zone that you define (see Section 7.5.3: Defining zones).

   NB: If the purpose of analysis option that has been selected in the *General* form > *General Information* tab > *Project Details* sub-tab is EPC generation, then iSBEM's default value for air permeability will be 25 $m^3/h.m^2$, while if compliance with building regulations has been selected as the purpose of analysis, the default value will be 10 $m^3/h.m^2$. In either case, the user can over-write the default value by manually entering an alternative value.

NB: According to ADL2A, buildings with less than 500 m^2 total useful floor area may avoid the need for a pressure test provided that the air permeability is taken as 15 $m^3/(h.m^2)$ at 50 Pa. SBEM is able to acknowledge this during the compliance checking.

[v] For further details on global values, see Section 6.1: Basic interface functionality and buttons.

Further guidance

Convention: Convention for EPCs - Air permeability

To accommodate different ages and types of building where the SBEM default value of 25 $m^3/h\ m^2$ for all existing buildings has been viewed as unduly restrictive, the value shall be amended as follows:

- Less than 10 $m^3/h.m^2$ – only with an accredited air pressure test result

- 10 m^3/hm^2 – buildings with total floor area > 500 m^2, built to 2002 Building Regulations

- 15 m^3/hm^2 – buildings with total floor area <= 500 m^2, built to 2002 Building Regulations and buildings built to 1995 Building Regulations

- 25 m^3/hm^2 – buildings built to Building Regulations pre 1995

- 35 m^3/hm^2 – to be considered where buildings are pre 1995 regulations and where suitable evidence of high permeability exists, e.g., single skin metal-clad structure within "Planning Use Class B2 – B8" with large roller shutter doors and poor constructional details, etc.

Building Orientation

2. Building (clockwise) rotation – In degrees from north.

   NB: For example, Figure 33, a rotation of 45 degrees would change north-facing walls to north-east. However, note that the nomenclature in the names of already created envelopes (denoting orientation) would not be changed automatically by the rotation. Also, note that any envelope created after the rotation is performed will still retain the original coordinate system. Hence, this parameter should be changed with caution from the default of zero.

   NB: The "Building rotation" parameter can be used when you want to model a building identical to one you have already modelled in iSBEM before (and therefore have its nct file), but which has a different orientation to the original one. As such, this parameter can be used to rotate the whole building as described in the guidance, provided you do not need to make any further modifications to the geometry of the building.

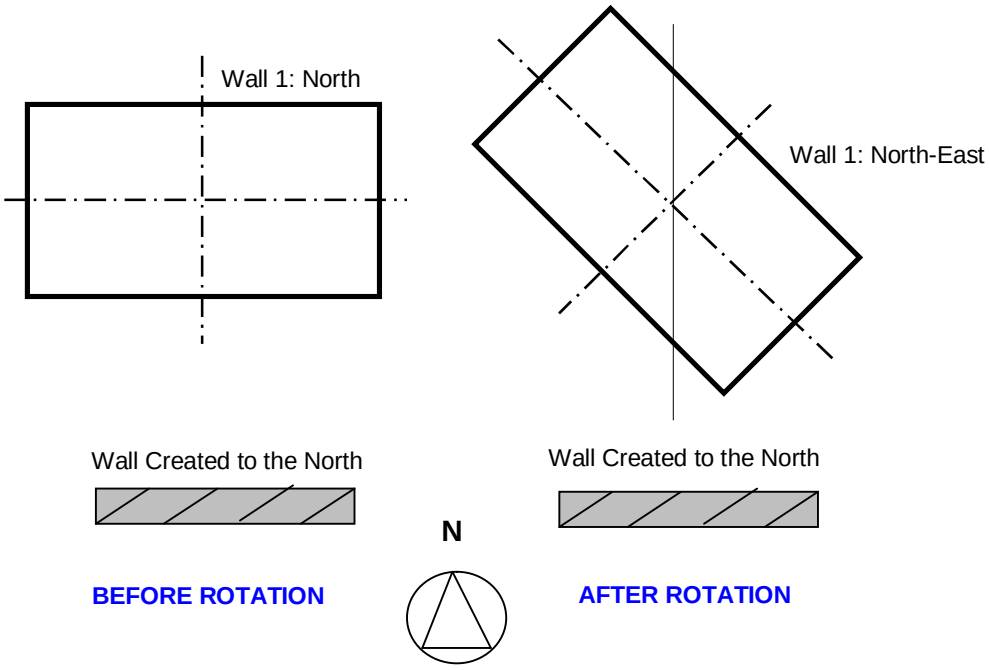


Figure 33: Example of a 45 degree building rotation

NB: The user is no longer required to enter the building height (height to eaves, in m).

Building Details

3. Zone height (Global) – Floor to floor height (floor to soffit for top floor), in m, i.e., including floor void, ceiling void, and floor slab. As with the global building infiltration parameter, the value you enter here will be given as the global or default zone height in each of the zones. You can choose to use this global value or enter a new value for each respective zone (see Section 7.5.3: Defining zones).

   NB: For a zone with a flat roof, the zone height would be from top of floor to top of roof. For a zone with a pitched roof and a flat ceiling underneath it, the zone height would be from top of floor to underside of soffit. For a zone with a sloping roof (i.e., an exposed pitched roof with no flat ceiling underneath it), the zone height would be from top of floor to soffit height. If there is a suspended floor, the zone height would be measured from the floor surface (rather than the slab underneath it).

4. Building area – The total building (sum of zone areas) floor area (m^2) – This field is for data entry checking purposes only (i.e., the value entered into this field is not used in any part of the calculation). The user can compare this figure to the figure calculated by iSBEM and reported directly below: "Currently the total zone area is…" which is a sum of all the areas of the entered zones. A red warning will appear if these values are not identical.

Section 6 (Scotland), Accredited Construction Details

5. Tick box to indicate if the building is designed and built following the guidance in Accredited Construction Details (Scotland) – This parameter is active only if the "Purpose of Analysis" parameter is set to 'Scottish Building Regulations' in the *General* form > *General Information* tab > *Project Details* sub-tab. Ticking the box indicates that the building, which is being modelled in iSBEM, is designed and built following the guidance in Accredited Construction Details (Scotland). Otherwise, the box should not be ticked.

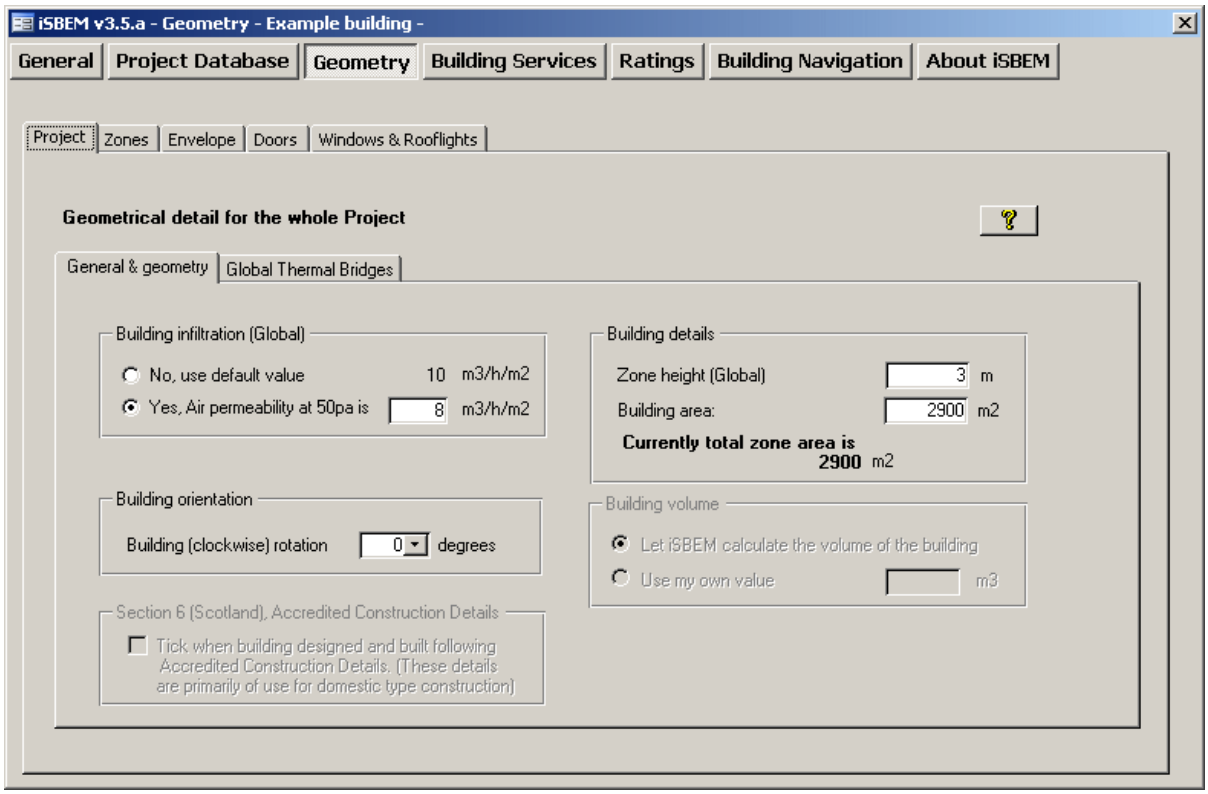


Figure 34: General & Geometry sub-tab of Project tab in the Geometry form

Thermal bridges sub-tab:

The *Thermal bridges* sub-tab allows you to define 'global' Psi values for thermal bridges. These global values can be selected when defining a zone so that you do not need to define the thermal bridges separately for each zone. If, however, the global values you define here do not apply to a specific zone, you can always choose not to use the global values (when defining the zone) and enter new values for that specific zone (see Section 7.5.3: Defining zones).

SBEM requires information about non-repeating thermal bridges[vi] associated with junctions between envelope elements, windows, and doors which are in contact with the exterior as shown in Figure 35: Defining the global thermal bridges (see footnote below on types of thermal bridges).

These types of junctions fall into two categories:

1. Junctions involving metal cladding
2. Junctions NOT involving metal cladding.

For each type of junction, you can enter an Psi value (W/mK) or leave the default values. For junctions not involving metal cladding, you can also tick a box indicating whether or not that type of junction complies with the relevant standards. The standards for junctions not involving metal cladding are Accredited Robust Details. The default Psi values for junctions involving metal cladding are compliant with the Metal Cladding and Roofing Manufacturers Association (MCRMA) standards.

In Figure 35, the defaults for all the junctions in the building have been set to comply with the relevant Accredited Robust Details standards and use the tool's defaults, except for the roof-to-wall junctions involving metal cladding, where an Psi value has been manually added as an example.

[vi] **Note on types of thermal bridges:** There are two types of thermal bridge; repeating and non-repeating. Repeating thermal bridges should be taken into account when calculating the U-value of a construction. Non-repeating thermal bridges can arise from a number of situations, but SBEM is only concerned with those arising from junctions between envelope elements, windows, and doors which are in contact with the exterior as shown in Figure 35.

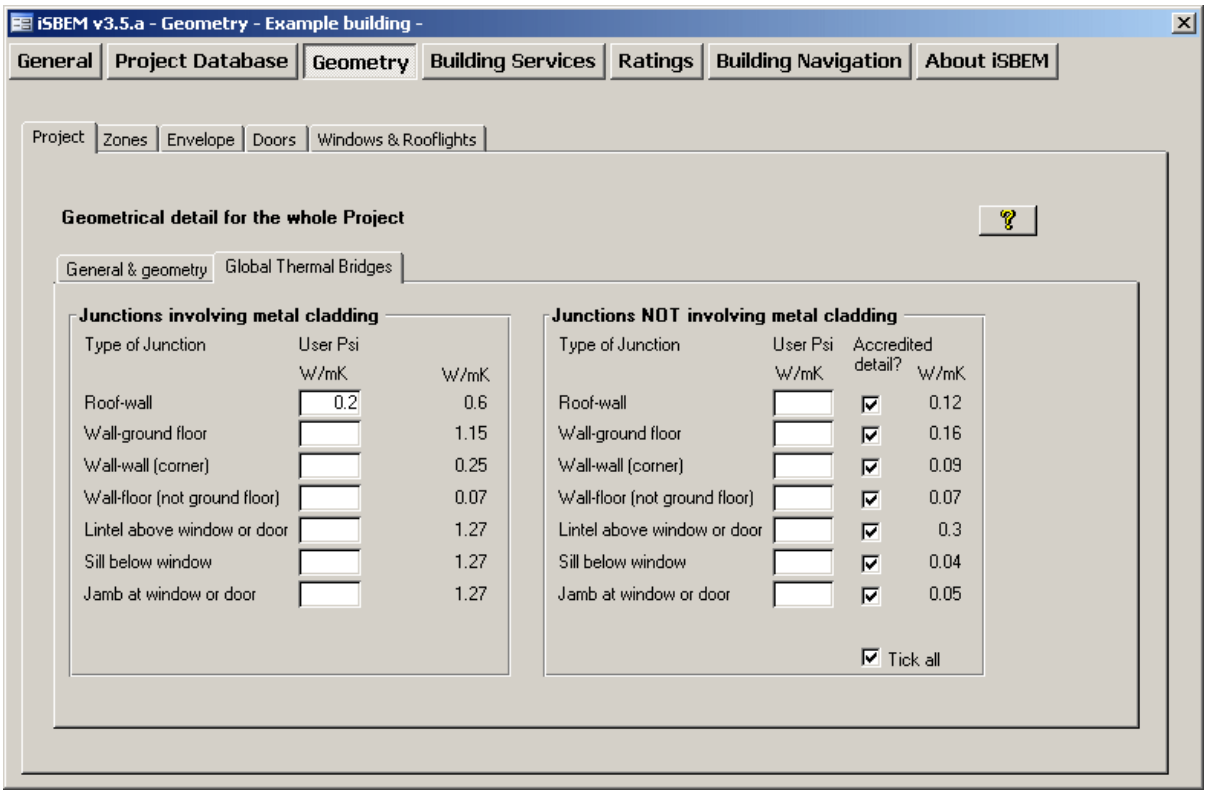


Figure 35: Defining the global thermal bridges

NB: Thermal bridging at junctions and around openings, which is not covered in Accredited Construction Details [1] or MCRMA guidance [2], needs to be accounted for, and this may be done using the method in BRE Information Paper IP 1/06, making use, where appropriate, of the new publication on conventions for temperature factors and linear thermal transmittance [3].

For buildings in Scotland, accredited construction details are given in the SBSA website [http://www.sbsa.gov.uk].

[1] Accredited Construction Details for limiting thermal bridging and air leakage. Details on http://www.communities.gov.uk

[2] Design of metal roofing and cladding systems: Guidance to complement Approved Documents L2A and L2B. MCRMA Technical paper no. 17, joint publication by MCRMA and EPIC, 2006

[3] Conventions for calculating temperature factors and linear thermal transmittance (in preparation).

7.5.3. Defining zones – Zones tab

The first step in defining the geometry of a zone is to create the zone in the *Zones* tab of the *Geometry* form.

NB: For building regulations calculations purposes, we recommend that users generally avoid creating more than 100-150 zones in iSBEM. However, the processing time will depend on the total number of objects (not just zones), i.e., zones, envelopes, windows, etc. Note that for building regulations compliance checking, the calculation has to generate 2 buildings: the actual and notional, so the number of objects (all the zones, envelopes, windows, etc.) that the calculation has to process is multiplied by 2, while for the asset rating to be calculated for an EPC, 4 buildings need to be generated: actual, notional, typical, and reference, i.e., all the objects in the input are multiplied by 4 to give the total number of objects being processed by SBEM. Hence, creating a project with a very large number of objects will slow down calculation and may cause it to crash.

The *Zones* tab contains four sub-tabs:

- **General** sub-tab: This is where the zones are created and defined. You need to give each zone a unique name, select its building and activity types, and enter its area, height, and infiltration characteristics. You can also specify which HVAC system the zone is served by in this tab (but only if you have already defined the HVAC system in the *Building Services* form or you are using one of the default HVAC systems in iSBEM). (see below).
- **Quick Envelopes** sub-tab: This is one way to define the envelope elements and assign them to the zone as described in Section 7.5.8: Quick Envelopes tab: Short cut to creating envelopes and windows.
- **Thermal bridges** sub-tab: This is where the global thermal bridges for the zone are defined (see below).
- **Envelope Summary** sub-tab: This tab displays a summary of all the envelope elements of the zone.

General sub-tab:

To create a zone, you will need to click into the *General* sub-tab of the *Zones* tab, add a new record, and enter the following information:

1. Name – Any name can be given to a zone. The only requirement is that it is unique. There are certain recommendations to avoid it becoming complicated since there are so many elements in iSBEM which require naming. See Section 3.5: iSBEM nomenclature, for guidance on how to name your zones, envelope elements, doors, and windows.
2. Multiplier – Indicate how many zones exactly identical to this one exist in the building (if more than the default of 1). Remember that this would also "multiply" all of its associated envelopes, windows, doors, and additional thermal bridges during the calculation.
3. HVAC System – If you have defined your HVAC systems before defining your zones (i.e., if you have started with the *Building Services* form instead of the *Geometry* form), you can select the HVAC system that serves this zone from the drop-down list. If no HVAC system serves the space (i.e., an unconditioned zone), select 'Zones without HVAC system' (spaces which have no heating or cooling, e.g., plant rooms, storage spaces, exposed circulation spaces). If you have not yet defined your HVAC system, this can be left as 'Unassigned' at this stage. You will be able to assign the zones to an HVAC system later within the *Building Services* form so there is no need to define the HVAC system before continuing. If you leave the zone as unassigned, a red warning will appear in the top right hand corner to let you know how many zones remain unassigned.

Further guidance

NB: If a zone is defined as having no heating or cooling, i.e., assigned to 'Zones without HVAC system', but the activity type selected for the zone is one which typically requires conditioning (according to the Activity Database), a red exclamation mark "**!**" will appear next to this parameter as a warning to the user, in case this was done in error. Ultimately, however, the calculation will be carried out using the data input by the user.

If you do not know the type of the HVAC system in your existing building or its detailed parameters, you should select one of the following default options from the drop-down menu (see Section 7.6: Building Services form):

- 'Heating only - Electric resistance' - Heat generated by passing current through resistance wire. Assumed to be electric central heating system with warm air distribution. Fan storage heaters and electric fan converters should be input by defining an HVAC system in the *Building Services* form > *HVAC Systems* tab > *General* sub-tab and selecting the system type "Other local room heater - fanned". If you do not know the heating method (i.e., whether a heated-only building uses electricity or a fuel-based heating system), you should select electric resistance heating as your default.

- ‘Heating only - Other systems’ - Assumed to be wet radiator system, heat generated by fuel combustion. Pumps assumed to be powered by grid-supplied electricity. If you know the fuel type used by the heating system, you can define it in the *Building Services* form > *Global and Defaults* tab > *HVAC System Defaults* sub-tab (see Section 7.6.1: Global and Defaults tab).
- ‘Heating and mechanical cooling’ - Assumed to be constant volume air system with terminal reheat and fixed fresh air. Refrigeration (chillers), fans, and pumps assumed to be powered by grid-supplied electricity. If you know the fuel type used by the heating system, you can define it in the *Building Services* form > *Global and Defaults* tab > *HVAC System Defaults* sub-tab (see Section 7.6.1: Global and Defaults tab).

NB: The default HVAC systems are representative of existing rather than new buildings and should only be used if you do not know the type of the HVAC system in your building or its detailed parameters as the default efficiencies assumed by iSBEM for them are quite pessimistic and cannot be edited by the user.

NB: See note in Section 7.6.8: Defining the zone specific building services, regarding indirectly conditioned spaces.

4. Building type – The default for this field is the building type that was selected when creating the project (this information is recorded in the *General Information* tab in the *General* form). It can, however, be changed for any particular zone, if appropriate (see note below).
5. Activity type – A building can be divided into a number of activity areas. For example, in an office building, there may be a reception, open plan office, some cellular offices, a tea room, and some toilets. When you choose your building type and activity area, you are setting a number of default parameters which the tool uses to calculate the energy consumption. These parameters include temperature set points, heat gains from people and equipment, required illuminance, and fresh air requirements amongst others. Each building type has a number of different activity areas to choose from. The description of the activity area, as it appears in the NCM Activity Database, is displayed in a box at the right-hand side of the sub-tab. For more information on building types and activity areas, please refer to the NCM Modelling Guide to be published by CLG or the NCM Activity Database (available for download from the NCM website[vii].

NB: It is not a problem in iSBEM to introduce activities from building types other than the default building type introduced at the beginning of an iSBEM project. For example, an office may have activities from the “Office” building type (e.g., open plan office, meeting room, tea making, etc...) but may also have atypical activities which are not included in the office building type, e.g., a shop, in which case the user would need to use a “Retail” building activity such as 'General Sales Area' or similar. The building type does not need to be the same for all activities in a project. It is intended to be a default for the project in iSBEM (could apply to other interfaces) and provides a 'filter' on the many activities available, making it easier for users to make a choice of activity for each zone. Generally, activities from the default building type should be used, but if there is nothing suitable available, another building type could be used.

NB: Domestic-type activities were added to the options available under the building type “Dwelling” in iSBEM in order to allow the energy calculations for the generation of one EPC for a building which contains residential accommodation above a non-domestic space (e.g., a shop or a pub) provided that the residential space can only be accessed from within the non-domestic space, i.e., the residential part is not designed or altered for use as a separate independent dwelling. In addition to common circulation areas of apartment buildings containing self-contained flats (as described in the next note), these are the **only** cases where SBEM can be used to model domestic activities. For more information on the appropriate software tools to use for modelling your building, please refer to CLG’s publication: “Improving the energy efficiency of our buildings: A guide to energy performance certificates for the construction, sale and let of

[vii] www.ncm.bre.co.uk

non-dwellings" which can be accessed from CLG's website at www.communities.gov.uk/archived/publications/planningandbuilding/guidancenondwellings.

NB: Only the communal areas of apartment buildings containing self-contained flats should be assessed for compliance using SBEM, for example, circulation areas (using the "Common circulation areas" activity under the building type "DWELLING"). The self-contained flats themselves should be assessed using SAP (for domestic buildings).

6. Area - Floor area of the zone, in m^2, calculated using the internal horizontal dimensions between the internal surfaces of the external zone walls and half-way through the thickness of the internal zone walls (see Section 3.4: Measurement and other conventions, and Figure 3). This parameter is used to multiply area-related parameters in the databases. The area basis needs to be consistent with that for Operational Ratings.

NB: If the zone has any virtual boundaries created due to the zoning rules on daylight access, you need to consider the area of the zone as that delimited by the 'line' created by that virtual boundary (the virtual boundary itself is not entered into iSBEM).

NB: Where there is an unheated, unoccupied roof space (i.e., between a pitched roof and a flat ceiling) above an activity area, it should not be treated as a separate unheated zone. Instead, the void should be considered as part of the construction when calculating the U-value between the occupied activity area and the outside (i.e., the top floor ceiling should be defined as a 'roof' and given the combined thermal performance of the whole construction including the ceiling construction, the void, and the roof construction). If the roof space is occupied (heated), then it becomes a normal activity area. If surfaces of the room are not rectilinear, for example, if a pitched roof is exposed to the inside of the conditioned zone (i.e., there is no flat ceiling underneath it), then the roof area will be that of the inner surface area of the roof as "seen" by the heat flux.

7. Zone height – Floor to floor height (floor to soffit for the top floor), in m, i.e., including floor void, ceiling void, and floor slab, is used for calculating the length of the wall-to-wall junctions and radiant and temperature gradient corrections. Either enter you own figure into the box, or click on the Global button (G). Pressing the Global button brings the global default value, which you previously defined in the *Projects* tab, into the field.

   NB: For a zone with a flat roof, the zone height would be from top of floor to top of roof. For a zone with a pitched roof and a flat ceiling underneath it, the zone height would be from top of floor to underside of soffit. For a zone with a sloping roof (i.e., an exposed pitched roof with no flat ceiling underneath it), the zone height would be from top of floor to soffit height. If there is a suspended floor, the zone height would be measured from the floor surface (rather than the slab underneath it).

Infiltration

8. Air permeability at 50pa, in $m^3/h.m^2$ - Similar to the zone height, you have the option to either enter you own value or use the global value which you previously defined in the *Projects* tab by clicking on the Global button. Otherwise, a default value (visible in the interface) will be used by the software.

   NB: If the purpose of analysis option that has been selected in the *General* form > *General Information* tab > *Project Details* sub-tab is EPC generation, then iSBEM's default value for air permeability will be 25 $m^3/h.m^2$, while if only compliance with building regulations has been selected as the purpose of analysis, the default value will be 10 $m^3/h.m^2$. In either case, the user can over-write the default value by manually entering an alternative value. For EPCs of existing buildings, note that the air permeability convention given in section 7.5.2: Project tab should apply.

Further guidance

NB: According to ADL2A, buildings with less than 500 m^2 total useful floor area may avoid the need for a pressure test provided that the air permeability is taken as 15 $m^3/(h.m^2)$ at 50 Pa. SBEM is able to acknowledge this in the compliance checking module.

9. Thermal bridges:

a. Tick here to use global psi values – If the box is ticked, the *Thermal Bridges* sub-tab disappears and the global psi values defined in the *Project* tab of the *Geometry* form are applied to the selected zone.

10. User's notes – This box is provided for the user to fill in, at their discretion, any details (description) about the zone that are not covered by the other fields. iSBEM does not process the entry in this field.

Figure 36 shows a zone being defined.

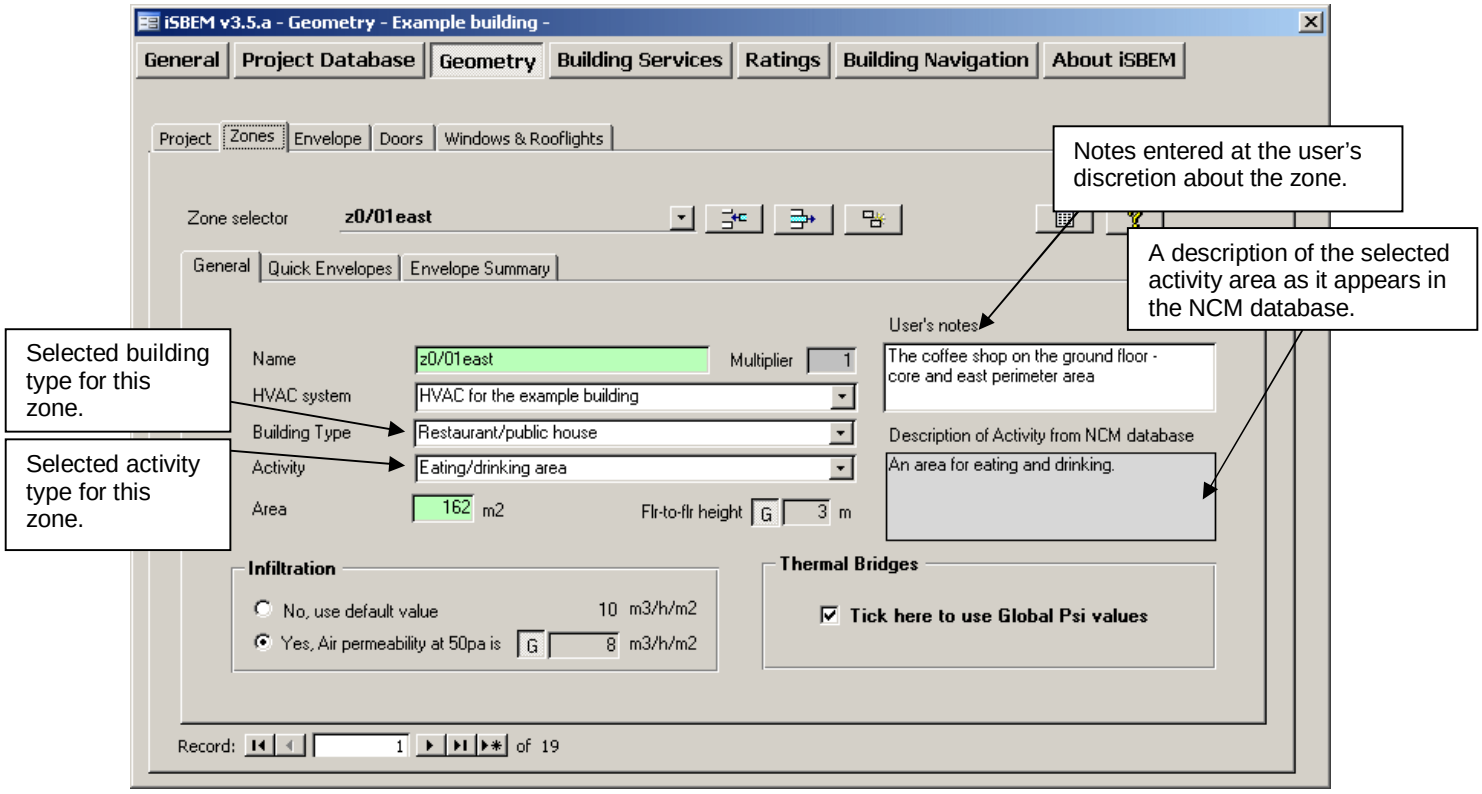


Figure 36: A zone being defined in the General sub-tab of the Zones tab in the Geometry form

At the top right hand side of the *Zones* tab, a message (in red text) will appear indicating how many zones have not yet been assigned to HVAC systems. To see a list of all the zones which have not been assigned, click on the Reports button to access the *Unassigned Objects* report (for more details about the Objects reports, see Section 7.9: Double-checking the data).

Notes on viewing/deleting/copying zones

To **view** the zones that you have created, you need to click on the record selector in the *Zones* tab. A drop-down list will then appear showing all of the zones that you have defined in that project. To the right of the zone's name will be the HVAC system which that zone has been assigned to. If a zone has not been assigned to an HVAC system it will say "Unassigned".

NB: At this stage in the tutorial, you will not have created the HVAC system yet so it will say "Unassigned" to the right of your zones.

To **delete** a zone (along with all its associated envelope elements, doors, and windows), you need to select it using the record selector, and then click on the "Delete record" button.

If you press the **copy** button, you will copy the selected zone along with all of the envelope elements, doors, and windows that have been created and linked to it. The new zone will be automatically named for you - it will be the "name of copied zone**.1**". Once it has been created, you can change its name. However, the names of the copied envelope elements, doors, and windows will still have the same names as those they were copied from. The following sections will explain how to rename and edit the envelope elements, doors, and windows. (There will be an option to just copy the zone by itself, without its child objects, in future versions of the tool.)

Task 5: Create Zone z0/02 in the General tab (the circulation area on the ground floor)

The building has already been zoned for you. See Figure 95: Ground floor plan and Figure 96: First floor plan in APPENDIX A:. A summary of the zoning, along with recommended names for the zones, is given in Table 17.

The six zones which make up the coffee shop have been entered for you so you can start by entering the information for Zone z0/02. Firstly, click on the *Geometry* form and the *Zones* tab. You should then be in the *General* sub-tab. Add a new record and, by referring to APPENDIX A:, enter the zone's name, select the appropriate building and activity types, and finally, enter the zone's area and height.

Using the record selector, you should now be able to view seven zones in total.

Thermal Bridge sub-tab:

If the tick box 'tick here to use global psi values' in the *General* sub-tab of the *Zones* tab (see above) is not ticked, the *Thermal Bridges* sub-tab will be visible, as shown in Figure 37. Here, you can define any thermal bridges that might occur in the selected zone relating to junctions between envelope elements, windows, and doors which are in contact with the exterior. This is done in the same way as setting the global defaults for thermal bridges in the *Projects* tab (see Section 7.5.2: Project tab).

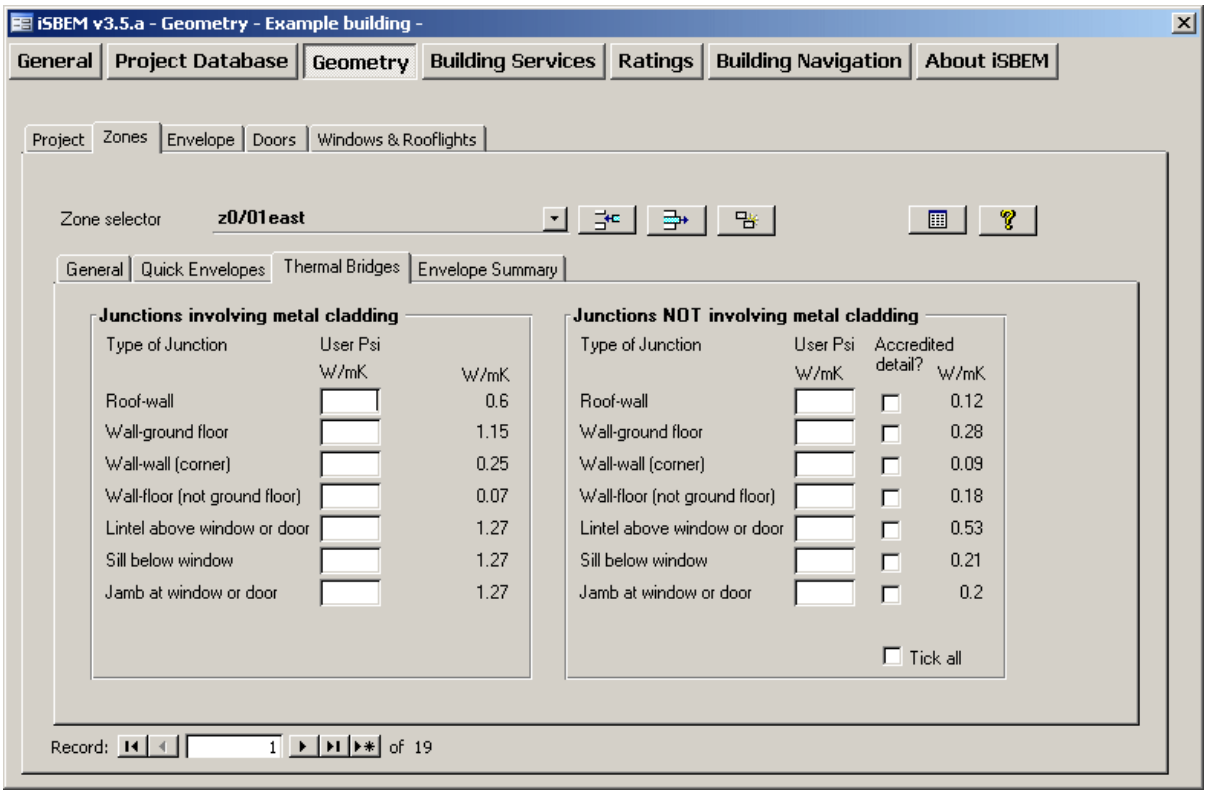


Figure 37: The Thermal Bridge sub-tab of the Zones tab

Envelope Summary sub-tab:

The envelope elements of a zone can be viewed in the *Envelope Summary* sub-tab of the *Zones* tab, shown in Figure 38, (see Section 7.5.4: Defining envelopes – Envelope tab for details on how the envelopes for each zone are created). Depending on which radio button is selected in the 'Show Objects' section, you can choose to either view only the envelopes attached to the zone or view the zone's envelopes as well as any windows or doors assigned to the envelopes. The zone's envelopes are listed in the left hand side window in terms of their names and types of envelope (wall/floor/roof). If any of the envelopes, windows, or doors, are highlighted in the left hand side window, more details about that object appear in the 'Selected objects properties' window, such as its area, construction, and the condition of the space it connects the zone to. Also included in the details is the ID number given by iSBEM to this envelope. This ID number can be used to locate this particular envelope quickly in the Envelope tab should any editing of its parameters be required (see Section 7.5.4: Defining envelopes – Envelope tab).

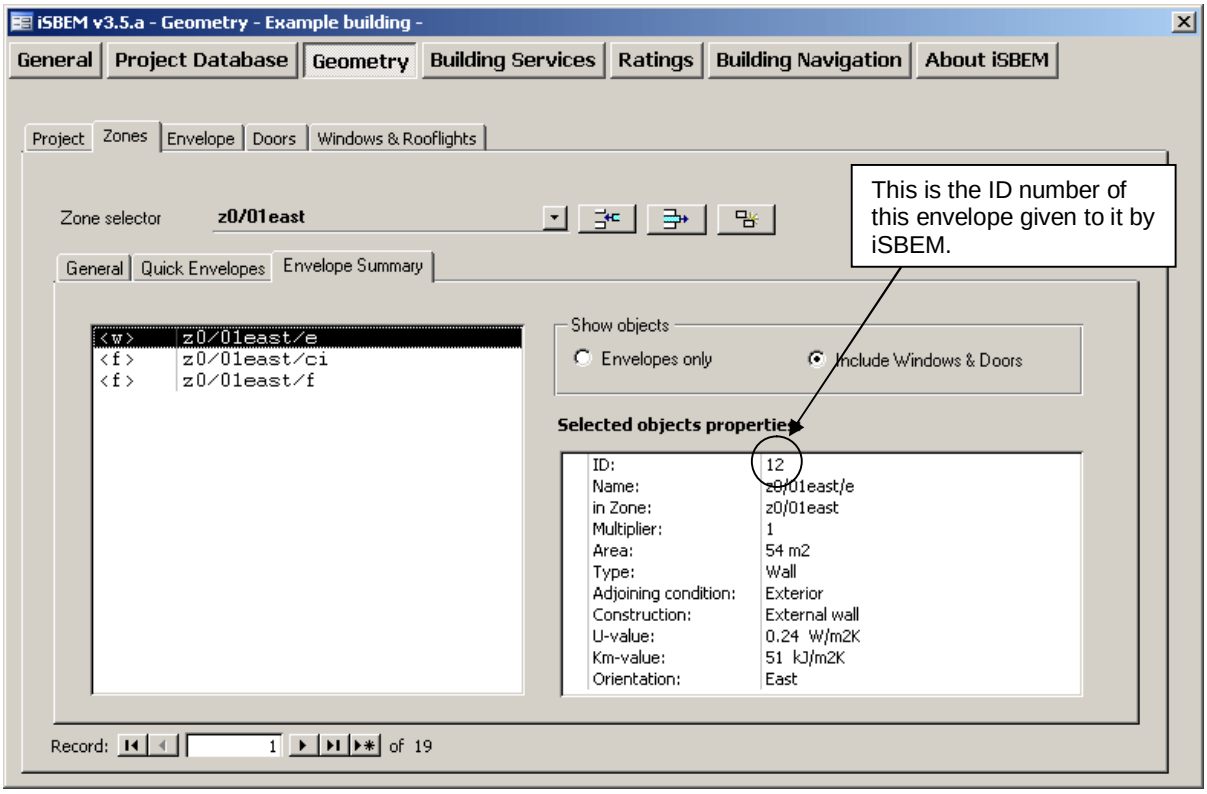


Figure 38: Envelope Summary sub-tab

NB: the *Quick Envelope* function will be explained in Section 7.5.8: Quick Envelopes tab: Short cut to creating envelopes and windows.

7.5.4. Defining envelopes – Envelope tab

The second stage of defining the geometry of a zone is to define its envelopes (walls, floor, and ceiling/roof). There are two ways of doing this:

1. In the *Envelopes* tab – Where you can create the envelope elements and define all of their parameters. This method is explained below.
2. In the *Quick Envelopes* sub-tab of the *Zones* tab - Where you can create and define the basic parameters for the envelope elements and windows. This is explained in Section 7.5.8. There are some parameters, however, for both envelope elements and windows which can only be defined in their main tabs. These tabs will, therefore, be explained first.

The main *Envelope* tab, shown in Figure 39, contains two sub-tabs:

General sub-tab: This is where you can create and define the envelope elements in terms of name, area, orientation, construction type, what type of space it is connected to, and its (additional) thermal bridges.

Window & Door Summary sub-tab: This tab displays a summary of the windows and doors present in each envelope element.

General sub-tab:

For each envelope element, you will need to click into the *General* sub-tab of the *Envelope* tab, create a new record, and add the following information:

1. Name – Similar to the naming of the zones (see Section 3.5 for more information).
2. Multiplier – Indicates how many envelope elements identical to this one exist in the selected zone. Remember that this would also "multiply" all of its associated windows, doors, and additional thermal bridges during the calculation.
3. Zone – Here you need to select the zone from the drop-down list (of zones defined so far) which this envelope element is part of.
4. Type of envelope – Choose between wall, floor/ceiling, and roof.
5. If you select roof, a tick box appears:
    i. Is the roof flat[viii]? – Tick the box to indicate if the roof is flat. Otherwise, the tool will assume it is pitched.

NB: Smoke vents are no longer used in the SBEM calculation, and so their input into iSBEM is no longer required. Compliance checking with respect to their U-values will, therefore, need to be carried out outside of SBEM.

6. NEW Connects space to (sometimes referred to as "adjacent condition") – Here you need to select what conditions apply on the other side of the wall/floor/ceiling/roof. If you click the Global button, the condition associated with the type of construction selected below (as has been defined in the *Project Database* form) will be inserted as the default. If this is not appropriate, you can un-click the Global button and select between: Conditioned adjoining space, External, Strongly ventilated, Underground, Unheated space, or Same space (see Table 9).

Option	Brief Description
Exterior	For an envelope separating the considered zone from the outside air or water.
Strongly ventilated spaces	For an envelope separating the considered zone from a space provided with one or more permanent openings (i.e., that cannot be closed), with a capacity for the supply of fresh air and extract of inside air, determined according to section 5.3 of NEN 1087, of at least $3x10^{-3}$ m3/s per m^2 useable area.
Unheated adjoining space	For an envelope separating the considered zone from an unheated adjoining space, other than meant under 'Strongly ventilated spaces'.
Conditioned adjoining space	For an envelope separating the considered zone from another conditioned zone.
Underground	For an envelope separating the considered zone from the ground.
NEW Same space	For constructions representing the internal envelopes that separate contiguous zones which have been merged into one zone, i.e., the envelope is "contained" within the merged zone.

Table 9: Options for 'Connects space to' field for envelopes

[viii] A pitched roof has a pitch greater than 10 deg (If the roof's pitch is 10 deg or less, it can be considered flat). If the pitch is greater than 70 deg, it can be considered a wall.

Further guidance

Convention: Convention for EPCs - Adjacent condition of adjoining buildings

Unless evidence to the contrary is readily and easily available, all buildings adjoining that building or part-building which is being assessed, are assumed to be conditioned unless they are of "Planning Class B2 to B8" in which case, they are assumed to be unconditioned. This applies regardless of whether they are actually occupied or are inaccessible. This convention only applies for the assessment of EPCs.

NB: Note that the Building Regulations compliance check regarding U-values will be applied by the tool to all envelopes which are not adjacent to a 'Conditioned adjoining space'. Also note that the tool will not check the U-values of envelopes of unconditioned zones for compliance.

7. Construction – Here you need to select the type of construction. When you click the drop-down menu to the right of the construction field, you will be presented with all the constructions of that type (type of envelope defined above) that you have defined in the *Project Database* form, as well as a default construction. Select one of these. If you need another construction type, you will need to go back to the *Project Database* form and create it first.

8. Area – This is the area of envelope element inclusive of any windows and doors, in m^2. This value is used to calculate the fabric heat loss so this is the area to which the U-value is applied. For floors and flat roofs/ceilings, the envelope area is calculated in the same manner as the zone area (see Section 7.5.3: Defining zones and Section 3.4: Measurement and other conventions). The area for an exposed pitched roof (i.e., without an internal horizontal ceiling) will be that of the inner surface area of the roof. For vertical envelopes (i.e., walls), the area is calculated as follows:

   Area of vertical envelope element = h * w, where:

   h = floor to floor height (floor to soffit on top floor), in m, i.e., including floor void, ceiling void, and floor slab, and

   w = horizontal dimension of the wall. Limits for this horizontal dimension are defined by the type of the adjacent walls (usually at right angles to the vertical envelope element in question). If the adjacent wall is external or a perimeter wall, the limit will be the internal side of the adjacent wall. If the adjacent wall is internal, the limit will be half-way through its thickness.

Further guidance

Convention: Convention for EPCs - Boundary of assessed building when other buildings adjoin

Where there is a party wall between buildings, this is deemed (in compliance with the RICS definition of internal areas) to be a perimeter wall, and therefore, horizontal dimensions should be measured to the inside face from the side of the building being assessed.

NB: If surfaces of the room are not rectilinear, for example, if a pitched roof is exposed to the inside of the conditioned zone (i.e., there is no flat ceiling underneath it), then the roof area will be that of the inner surface area of the roof as "seen" by the heat flux.

Further guidance

Convention: Convention for EPCs - Dimension conventions

See APPENDIX H: for the treatment of other rooms with non-rectilinear surfaces.

Further guidance

NB: During the calculation, if the area of the wall input is less than the total area of windows and doors defined within in, SBEM will increase the area of the wall to fit the areas of all the defined openings in it. The corresponding wall in the notional building will similarly have the increased area. Therefore, you should always ensure that you double-check the figures you input for your model geometry in iSBEM before running the calculation.

9. Orientation – Here you need to select from the drop-down menu whether the element faces north, north-east, east, etc., or is horizontal.

10. Additional Thermal Bridges – If there are any thermal bridges in addition to those already described in the *Thermal Bridges* sub-tab of *Project* tab (if the global values are being

applied) or the *Thermal Bridges* sub-tab of the *Zones* tab (if they are not), then they need to be entered here in terms of the length of the thermal bridge (m) and its linear thermal transmittance [the ψ (psi) value] (W/mK). (See notes in Section 7.5.2: Project tab regarding thermal bridges.).

11. Go to ID – this parameter can be used to quickly 'jump to' a particular envelope. The ID number of an envelope is visible among the envelope details displayed in the *Envelope Summary* sub-tab of the zone to which this envelope belongs. For example, if while reviewing the details in the *Envelope Summary* sub-tab, an error was detected in the description of a particular envelope, you can make a note of its ID number (Figure 38), go to the *Envelope* tab, type the ID number in the box, and press the arrow key . This will take you to the *General* sub-tab of that particular envelope where you can correct the error (see Envelope Summary sub-tab in section 7.5.3: Defining zones – Zones tab).

Figure 39 shows a wall being defined.

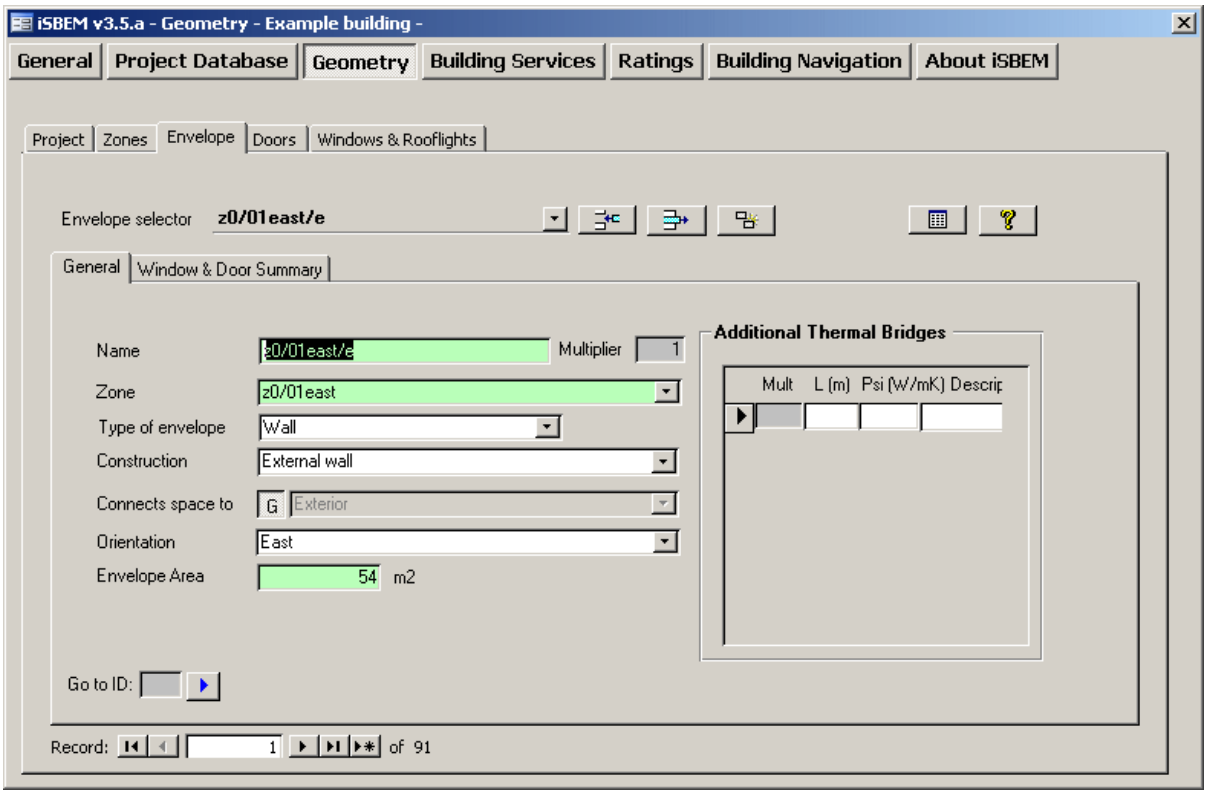


Figure 39: A wall being defined in the General sub-tab of the Envelope tab in the Geometry form

At the top right hand side of the *Envelope* tab, a message appears if any of the envelope elements have not yet been assigned to a zone. To see a list of all the envelope elements which have not been assigned to zones, click the Reports button (for more details about the Objects reports, see Section 7.9: Double-checking the data).

Task 6: Create all the envelope elements for Zone z0/02

The details on the walls, floors, and ceilings/roofs can be found in Table 17 in APPENDIX A:. First, click on the *Geometry* form and the *Envelope* tab. You should then be in the *General* sub-tab. For each new envelope element, you will need to add a new record and by referring to Table 17, enter its required parameters. Do this for all the envelope elements for Zone z0/02 (This includes the four walls, the floor, and the ceiling. (The envelope elements for Zones z0/01north, z0/01east, z0/01south, z0/01west, z0/01northwest, and z0/01southwest have been entered for you, and you will be able to view them using the record selector.)

Viewing, deleting, and copying envelope elements in the Envelope main tab

To **view** the envelope element that you have created, you need to click on the record selector in the main *Envelope* tab. A drop-down list will then appear showing all of the envelope elements that you have defined in that project. To the right of the envelope's name will be the zone which that envelope element is part of, followed by the HVAC system which the zone has been assigned to. If the zone has not been assigned to an HVAC system, it will say "Unassigned".

NB: At this stage in the tutorial, you will not have created any HVAC systems yet so it will say "Unassigned" to the right of your zones

Note that the first line in the drop-down box reads "*Select action or wall from the list*". This refers to actions that will be available in future versions of the tool, for example, sorting by zone or copying only part of the envelope (for example, copying a wall without its windows).

To **delete** an envelope element (and any associated windows or doors), you need to select it using the record selector and then click on the "Delete Record" button.

If you press the "Copy Record" button, you will **copy** the selected envelope element along with any windows and doors that have been created and linked to it. The new envelope will be automatically named for you - it will be the "name of copied envelope**.1**". Once it has been created, you can change its name. (The names of the copied windows and doors associated with the envelope, however, will have the same name as those they were copied from - the following section will explain how to rename and edit the windows).

Task 7: View the envelope elements you have created for zone z0/02 in the Envelope main tab AND in the Envelope Summary tab

First, using the record selector in the main *Envelope* tab, view the envelope elements that have been created in this project.

Then, go back to the *Zones* main tab, select zone z0/02, and click on the *Envelope Summary* sub-tab. Here, you should be able to see all the envelope elements that you have created in Task 6. If you have made any errors, you will need to go back to the main *Envelope* tab, and edit the envelope elements there.

Task 8: Create a new envelope element and then delete it

So that you become familiar with the functionality of the tool, try introducing a made-up envelope element for zone z0/02 using the *Envelope* tab. Once it has been sufficiently defined (i.e., the green fields have been filled in), you will be able to delete it.

Windows & Doors Summary sub-tab:

The windows and doors assigned to an envelope element can be viewed in the *Window & Door Summary* sub-tab of the *Envelope* tab, shown in Figure 40, (see Section 7.5.5: Defining windows, for details on creating windows and rooflights and Section 7.5.7: Defining doors, for details on creating doors). Depending on which radio button is selected in the 'Objects' section, you can choose to either view only the windows and rooflights attached to the envelope, view only the doors, or view the envelope's windows and rooflights as well as any doors. The envelope's windows and/or doors are then listed in the left hand side window in terms of their names and types (window/door). If any of the windows or doors are highlighted in the left hand side window, more details about that object appear in the 'Selected objects properties' window, such as its area and construction.

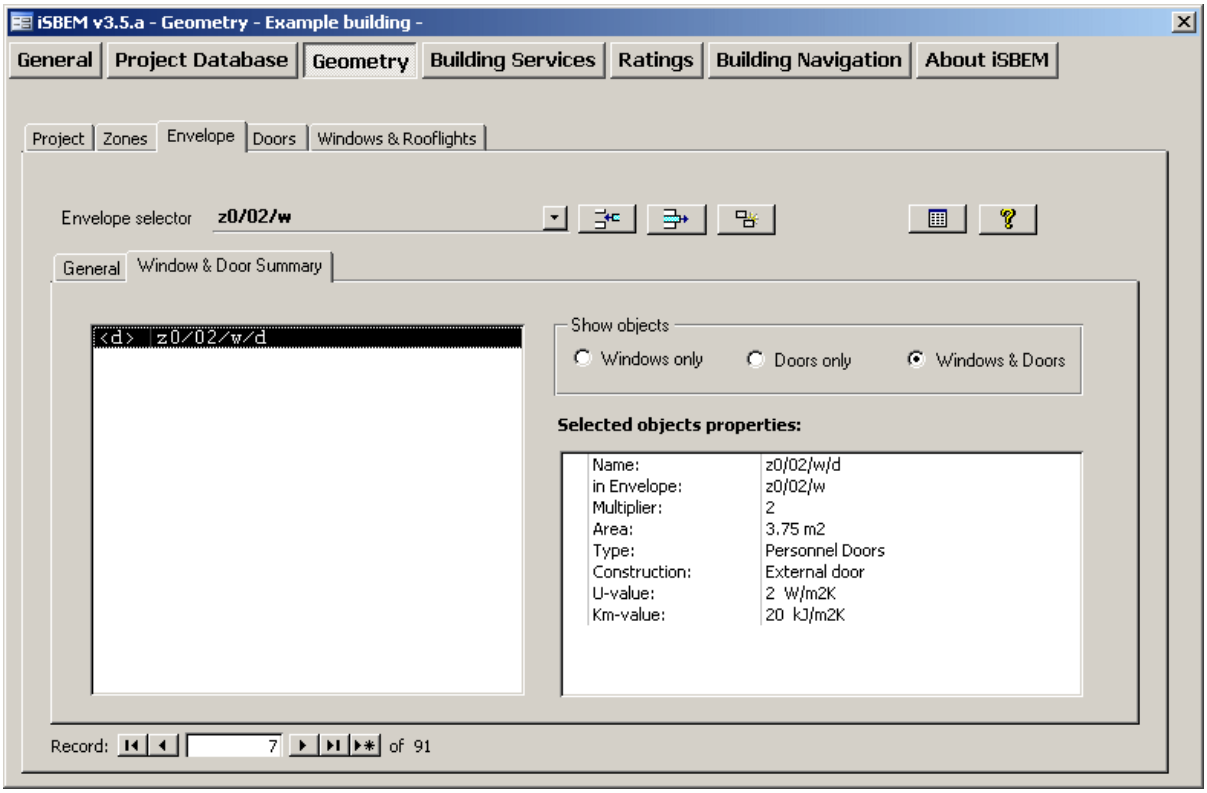


Figure 40: Windows & Doors Summary sub-tab

NB: the *Quick Envelope* function is explained in Section 7.5.8: Quick Envelopes tab: Short cut to creating envelopes and windows.)

7.5.5. Defining windows and rooflights – Windows & Rooflights tab

For each envelope element in the building, you need to define the type and amount of glazing it contains, if any. If there is more than one window of the same type in one wall/roof, you can add together the areas and enter them as one single window (or you can use the multiplier field). The principal way to define the windows is in the main *Windows & Rooflights* tab.

Rooflights are considered in the same way as windows in SBEM.

There is only one sub-tab in the *Windows & Rooflights* tab:

- **General** sub-tab.

General sub-tab:

This is where you need to enter the window name, assign it to an envelope element, enter the glazing type, area, shading system, transmission factor, and details of any additional thermal bridges.

NB: Internal windows and doors should not be entered into iSBEM.

For each window, you will need to create a new record and add the following information:

1. Name – As before, the name must be unique and should indicate which wall it is to be attached to (see Section 3.5: iSBEM Nomenclature, for more information).
2. Multiplier – Indicate how many windows identical to this one exist in the selected envelope element. Remember that this would also "multiply" all of its associated additional thermal bridges during the calculation.
3. In Envelope – Here, you need to select from the drop-down box, which envelope element this window is in (be it a wall or a roof).
4. Glazing type – Here, you need to select the type of glazing. When you click on the drop-down menu to the right of the glazing field, you will be presented with all the glazing types that you already defined in the *Project Database* form, as well as a default glazing.
5. Area – Area of the structural opening in the wall/roof including the frame, in m^2.

   NB: If the wall/roof is fully glazed, then the area of the window will be equal to the area of the wall/roof.

Further guidance

NB: During the calculation, if the area of the wall input is less than the total area of windows and doors defined within in, SBEM will increase the area of the wall to fit the areas of all the defined openings in it. The corresponding wall in the notional building will similarly have the increased area. Therefore, you should always ensure that you double-check the figures you input for your model geometry in iSBEM before running the calculation.

6. Surface area ratio – This is the "developed area to projected area" ratio for the window or rooflight. The developed area is the total area of the glass plus the frame, and the projected area is the area of the opening in the wall/roof. Therefore, for domed or conical rooflights, for example, this ratio would be larger than 1. It cannot have a value which is less than 1.
7. Area ratio covered – This is the ratio of the roof area covered by an array of rooflights to the total area of the rooflight glazing (see Figure 41 for example). This parameter is active only if the envelope to which this window belongs has been defined as a roof, i.e., the window is in fact a rooflight. **NB**: This parameter is used by SBEM to determine the area of the zone which is daylit by the array of rooflights for automatic daylight zoning sub-division (see Lighting (Controls) sub-tab in Section 7.6.8: Defining the zone specific building services- Zones tab). If the user is doing the daylight zoning manually, the "Area ratio covered" parameter is not relevant. If the calculated value for this parameter is larger than the maximum of 4, then the user can either enter the value as 4 or do the daylight subdivision manually for the zone containing this array of rooflights.
8. Display Window tick box – Tick this box if the window being defined is for display purposes (e.g., a shop front window), as defined in ADL2A.

NB: The compliance tool does not check 'display windows' for compliance with ADL2A with regards to the glazing's limiting standards for U-values.

NEW

9. Frame factor – This is the ratio of the window or rooflight area which is occupied by the frame. The default value is 0.1 for a window (i.e., 10% of the total area is occupied by the frame and 90% by the glazing) and 0.3 for a rooflight. It cannot have a value which is less than 0 or which is larger than 1.

10. Shading system – Here, you need to select from the drop-down box whether the window has: User-moveable external protection, Automatically-controlled external protection, or All other cases. This is used to calculate the reduction factor due to shading devices, which reduces the amount of solar heat gains through glazing.
11. Transmission factor – This is the fraction of light transmitted through that specific window after accounting for shading from overhangs and fins. (For details on how to calculate the transmission factor, see Section 7.5.6: Transmission correction factors.)
12. Thermal Bridges – Here, you need to define any thermal bridges <u>in addition</u> to those already described in the *Thermal Bridges* sub-tab of the *Project* tab (if the global values are being applied) or the *Thermal Bridges* sub-tab of the *Zones* tab (it they are not), in terms of the length of the thermal bridge (m) and its linear thermal transmittance [the ψ (psi) value] (W/mK). (See notes in Section 7.5.2: Project tab, regarding thermal bridges.)

NB: Doors which are more than 50% glazed should be entered into iSBEM as windows, and their light and solar characteristics should be entered into the *Project Database* form > *Glazing* tab. Doors which are 50% or less glazed can be treated as opaque doors.

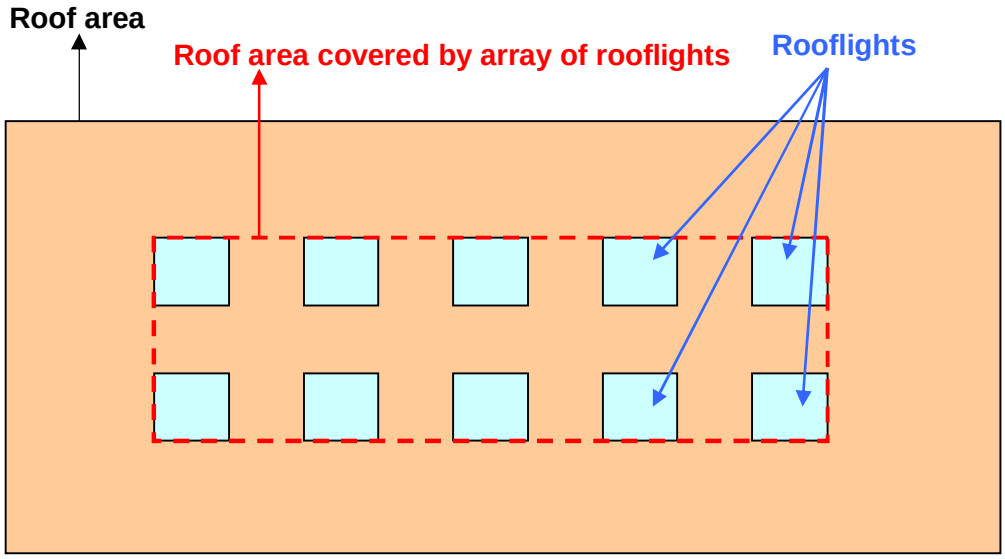


Figure 41: Area ratio covered for the definition of rooflights

<u>Example (Figure 41):</u>
Roof area covered by array of rooflights = 9 m x 3 m = 27 m^2.
Total area of rooflight glazing = 10 x 1 m^2 = 10 m^2
Area ratio covered for the example in the diagram = 27 m^2 / 10 m^2 = **2.7**

Figure 42 shows a window being defined.

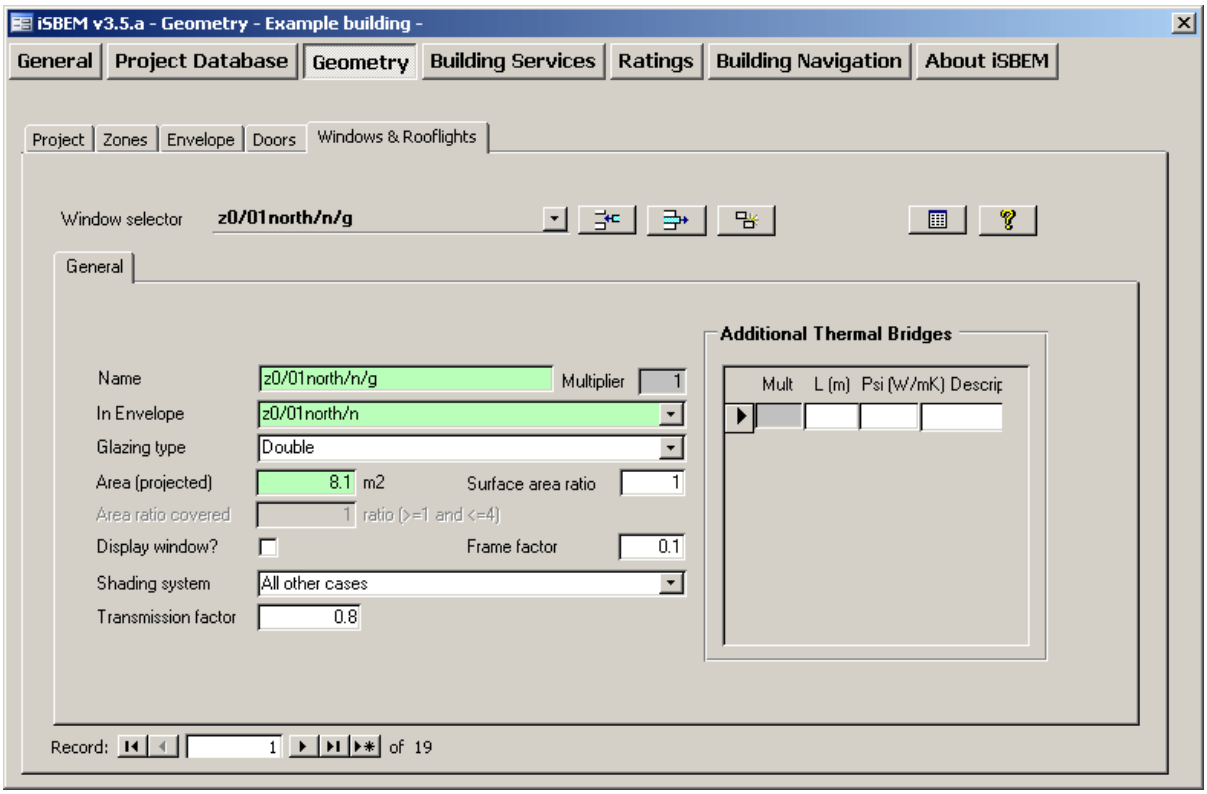


Figure 42: A window being defined in the General sub-tab of the Windows & Rooflights tab in the Geometry form

At the top right hand side of the *Windows* tab, a message will appear indicating how many windows have not yet been assigned to an envelope element. To see a list of all the windows which have not been assigned to envelope elements, click on the Reports button (for more details about the Objects reports, see Section 7.9: Double-checking the data).

Task 9: Create the windows for zone z0/01west

The details of all the glazing present in each zone are given in Table 17 in APPENDIX A:. First, click on the *Geometry* form, the *Windows & Rooflights* tab, and then the *General* sub-tab. For each new window, you will need to add a new record and by referring to Table 17, enter all the required parameters. Do this for the window in zone z0/01west (z0/01west/w/g).

Viewing, deleting, and copying windows in the Windows & Rooflights tab

To **view** the windows that you have created, you need to click on the record selector in the main windows tab. A drop-down list will then appear showing all of the windows that you have defined in that project. To the right of the window's name will be the names of the envelope element which that window is part of, followed by the name of the zone to which the envelope belongs.

Note that the first line in the drop-down box reads "*Select action or window from the list*". This refers to actions that will be available in future versions of the tool, for example, sorting by envelope element.

To **delete** a window, you need to select it using the record selector, and then click on the "Delete Record" button.

If you press the "Copy Record" button, you will **copy** the selected window. The new window will be automatically named for you – it will be the "name of copied window**.1**". Once it has been created, you can change its name.

Task 10: View the window that you have created for zone z0/01west in the Windows main tab AND in the Windows Summary tab

First, using the record selector in the main *Windows* tab, view the windows that have been created in this project. You should be able to see 7 (6 already created for you plus the one you have created).

Then, go back to the *Envelope* main tab, select envelope z0/01west/w, and click on the *Windows & Doors Summary* sub-tab. Here, you should be able to see the window that you have created in Task 9. If you have made any errors, you will need to go back to the main *Windows & Rooflights* tab and edit them.

Task 11: Create a window and then delete it

So that you become familiar with the functionality of the tool, try introducing a made-up window for zone z0/01west using the *Window & Rooflights* tab. Once it has been sufficiently defined (i.e., the green fields have been filled in), you will be able to delete it.

7.5.6. Transmission correction factors

The transmission factor for windows can be calculated from[ix]:

***T*S = *F*o *F*f**
where

***F*o** is the partial shading correction factor for overhangs, and
***F*f** is the partial shading correction factor for fins.

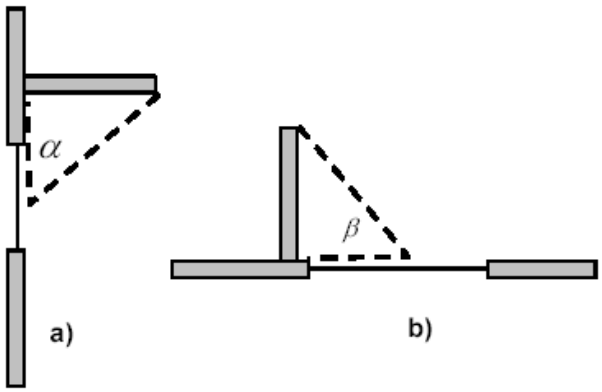
A transmission factor of 1 refers to 100% of light transmitted, i.e., no shading from fins or overhangs.

NB: The effect of shading from the horizon (e.g., the ground, trees, and other buildings) has not been considered for the calculations carried out by SBEM.

Shading from overhangs and fins

The shading from overhangs and fins depends on the overhang or fin angle, latitude, orientation, and local climate. Seasonal shading correction factors for typical climates are given in Table 10 and Table 11.

[ix] The source of the shading calculation due to fins and overhangs is the CEN standard "EN 13790: Energy performance of buildings — Calculation of energy use for space heating and cooling".



a) Vertical section b) Horizontal section

Key
α overhang angle
β fin angle

Figure 43: Shading from overhangs and fins

NB: For the purposes of this calculation, the angles alpha and beta, indicated by the dashed lines in Figure 43, are taken between the plane of the window and the overhang or fin shadow line at mid-window.

Overhang angle	45° N lat.			55° N lat.			65° N lat.		
	S	E/W	N	S	E/W	N	S	E/W	N
0°	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
30°	0,90	0,89	0,91	0,93	0,91	0,91	0,95	0,92	0,90
45°	0,74	0,76	0,80	0,80	0,79	0,80	0,85	0,81	0,80
60°	0,50	0,58	0,66	0,60	0,61	0,65	0,66	0,65	0,66

Table 10: Partial shading correction factor for overhang, *F*o

Fin angle	45° N lat.			55° N lat.			65° N lat.		
	S	E/W	N	S	E/W	N	S	E/W	N
0°	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
30°	0,94	0,92	1,00	0,94	0,91	0,99	0,94	0,90	0,98
45°	0,84	0,84	1,00	0,86	0,83	0,99	0,85	0,82	0,98
60°	0,72	0,75	1,00	0,74	0,75	0,99	0,73	0,73	0,98

Table 11: Partial shading correction factor for fins, *F*f

7.5.7. Defining doors – Doors tab

Only a zone's **external** doors need to be defined in iSBEM.

The *Doors* tab contains one sub-tab:

- **General** sub-tab

General sub-tab:

This is where you need to enter the name of the door, assign it to an envelope element, and enter its area, its construction type, its additional thermal bridges (if applicable), and what type of door it is.

NB: Internal windows and doors should not be entered into iSBEM.

For each door, you will need to create a new record and add the following information:

1. Name – As before, the name must be unique and must indicate which wall it is to be attached to (see Section 3.5: iSBEM Nomenclature, for more information).
2. Multiplier – Indicate how many doors identical to this one exist in the selected envelope element. Remember that this would also "multiply" all of its associated additional thermal bridges during the calculation.
3. In Envelope – Here, you need to select which element this door is part of from a drop-down box of the envelopes already created.
4. Type – Here, you need to select between: Personnel Doors, High Usage Entrance Doors, and Vehicle Access Doors, as defined in ADL2A.
5. Construction type – Here, you need to select the type of construction. When you click on the drop-down menu to the right of the construction field, you will be presented with all the constructions for doors that you defined in the *Project Database* form, as well as a default construction.
6. Area – Specifies the area of the door including the frame, in m^2, i.e., the area of the structural opening in the wall.

Further guidance

NB: During the calculation, if the area of the wall input is less than the total area of windows and doors defined within in, SBEM will increase the area of the wall to fit the areas of all the defined openings in it. The corresponding wall in the notional building will similarly have the increased area. Therefore, you should always ensure that you double-check the figures you input for your model geometry in iSBEM before running the calculation.

7. Thermal Bridges – Here, you need to define any thermal bridges in addition to those described in the *Thermal Bridges* sub-tab of *Project* tab (if the global values are being applied) or the *Thermal Bridges* sub-tab of the *Zones* tab (it they are not), in terms of the length of the thermal bridge (m) and its linear thermal transmittance [the ψ (psi) value] (W/mK). (See notes in Section 7.5.2: Project tab, regarding thermal bridges.)

NB: Doors which are more than 50% glazed should be entered into iSBEM as windows, and their light and solar characteristics should be entered into the *Project Database* form > *Glazing* tab. Doors which are 50% or less glazed can be treated as opaque doors.

Figure 44 shows a door being defined. In this example, two doors of 3.75 m^2 in area each have been entered.

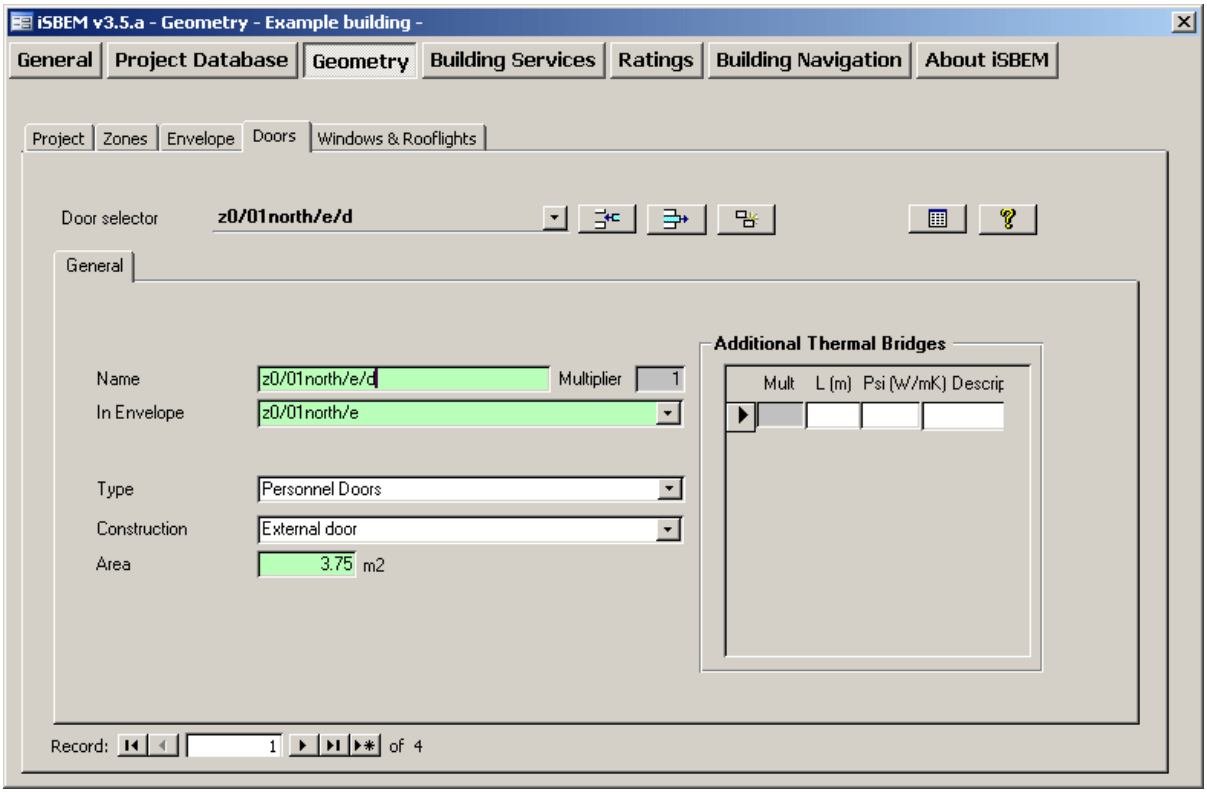


Figure 44: A Door being defined in the Doors tab

7.5.8. Quick Envelopes tab: Short cut to creating envelopes and windows

The *Quick Envelopes* sub-tab provides an alternative way of introducing the envelope elements and windows without having to assign them manually to a zone or envelope element, respectively.

The information required is a selection of the parameters required in the main *Envelope* and *Windows & Rooflights* tabs.

Envelopes elements and windows are created as follows:

The zone to which the envelopes and windows are to be assigned is defined by the zone selected using the record selector.

The type (wall, floor/ceiling, or roof) and orientation of the envelope element is defined by which row you enter your information into. The first eight rows are for creating walls with orientations S, SE, E, NE, N, NW, W, and SW, and the last three rows are for ceilings, floors, and roofs.

There are then three fields that need to be filled in for each envelope element:

1. Construction type (choose between a default construction and the constructions that you defined in the *Project Database* form).
2. Adjacent condition – Here you have 2 options:
   a. Leave the Global button pressed in and hence apply the global default adjacency condition that was associated with the selected construction in the *Project Database* form (see Section 7.4.1: Defining construction types) or
   b. Un-depress the Global button and select a condition from the drop-down menu (choose between: Exterior, Strongly ventilated spaces, Unheated adjoining space, Conditioned adjoining space, or Underground).

3. Area of the envelope (calculated as described in section 7.5.4: Defining envelopes – Envelope tab), in m^2.

If that envelope element has any windows or glazed areas, you need to fill in the following remaining fields:

4. Area of the window or rooflight, including the frame, in m^2. If you wish to define windows or rooflights (including the frames) using percentages of the envelope areas (as was the case in previous versions of iSBEM), then you need to untick the relevant box in the *General* form > *File Options* tab > *System Configuration (cont.)* sub-tab (see Section 7.3.1: File Options tab). The box is ticked by default .

   NB: Internal windows and doors should not be entered into iSBEM.

   NB: If the wall/roof is fully glazed, then the area of the window will be equal to, i.e. 100% of, the area of the wall/roof.

Further guidance

NB: During the calculation, if the area of the wall input is less than the total area of windows and doors defined within in, SBEM will increase the area of the wall to fit the areas of all the defined openings in it. The corresponding wall in the notional building will similarly have the increased area. Therefore, you should always ensure that you double-check the figures you input for your model geometry in iSBEM before running the calculation.

5. Glazing type (choose between a default glazing type and the glazing types that you defined in the *Project Database* form).
6. Disp? – Indicate whether it is a display window or not (as defined in ADL2A).

Once the information is entered, click on the **"Create Envelopes**" button to create the envelopes. Once the button has been clicked and the envelopes have been created, the contents of the Quick Envelopes tab will be automatically cleared. If you do not wish for the contents of the tab to be cleared after the creation of the envelopes, then you need to untick the relevant box in the *General* form > *File Options* tab > *System Configuration (cont.)* sub-tab (see Section 7.3.1: File Options tab). The box is ticked by default.

To **view** the envelopes and windows that you have created, go to the *Envelopes Summary* sub-tab (in the *Zones* tab) and the *Windows Summary* sub-tab (in the *Envelope* tab). All the envelopes and windows will be available for **editing** in the main *Envelope* and *Windows* tabs.

NB: The descriptions of the walls remain visible in the *Quick Envelopes* sub-tab until you clear the form (by pressing the "Clear all" button) or close the project. This is so you can use the same descriptions to start creating walls for a different zone and hence save time.

NB: Doors which are more than 50% glazed should be entered into iSBEM as windows, and their light and solar characteristics should be entered into the *Project Database* form > *Glazing* tab. Doors which are 50% or less glazed can be treated as opaque doors.

Further guidance

The parameters that you cannot define in the Quick Envelopes sub-tab include:

- Thermal bridges for envelope elements or windows - If the envelope or window you have created contains any thermal bridges in addition to those already described in the *Thermal Bridges* sub-tab of the *Project* tab (if the global values are being applied) or the *Thermal Bridges* sub-tab of the *Zones* tab (it they are not), you will need to go to the *Envelopes* and *Windows* main tabs, select the record in question, and add the thermal bridge manually. (See notes in Section 7.5.2: Project tab regarding thermal bridges.)
- Shading system - If the window or rooflight has anything but the default for this parameter (All other cases), then you will need to go to the *Windows & Rooflights* main tab, select the window in question using the record selector, and change the details manually.
- Transmission factor - If the window or rooflight has anything but the default for this parameter (1), then you will need to go to the *Windows & Rooflights* main tab, select the window in question using the record selector, and change the details manually.

- Surface area ratio – If the window or rooflight has anything but the default (1 for windows and 1.3 for rooflights) for this parameter, you will need to go to the *Windows & Rooflights* main tab, select the window in question using the record selector, and change the details manually.

NEW

- Frame factor – If the window or rooflight has anything but the default (0.1 for windows and 0.3 for rooflights) for this parameter, you will need to go to the *Windows & Rooflights* main tab, select the window in question using the record selector, and change the details manually.
- Area ratio covered – If the rooflight definition has anything but the default value (1) for this parameter, you will need to go to the *Windows & Rooflights* main tab, select the window in question using the record selector, and change the details manually.

Introducing a second envelope element with the same orientation:

If your zone has, for example, a second west-facing wall, you would need to create one west wall, click on the "Clear all" button to remove the information about the first west wall, enter the information about the second west wall, and then click on "Create envelopes" again. The tool would then add the second west wall to the already created envelopes.

Naming of the envelope elements and windows created in the Quick Envelopes tabs:

The names are created automatically as described in Chapter 3.

Figure 45 shows a wall and a window being defined in the *Quick Envelopes* tab. The example wall is a 15 m^2, external, south-facing wall, constructed from an External Wall specification that had previously been defined in the *Project Database* form. It has 50% glazing of a type previously defined in the *Project Database* form, and the glazing is not for a display window.

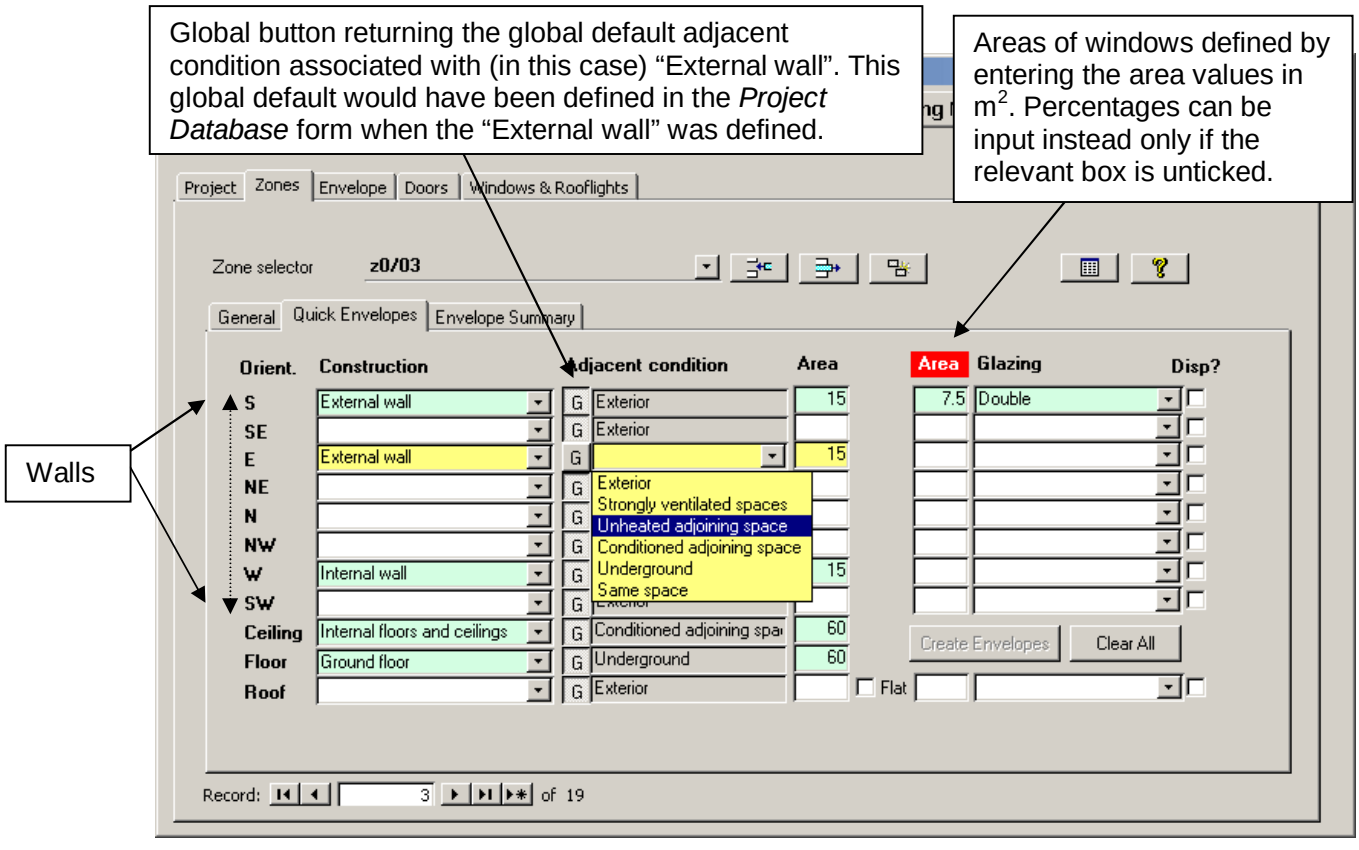


Figure 45: The Quick Envelopes sub-tab

Task 12: Create the remaining 12 zones, and define their envelopes and windows using Quick Envelopes:

Details on the remaining twelve zones are given in APPENDIX A: Table 17.

To create each new zone, you will need to go back to the *General* sub-tab of the *Zones* tab. To create a zone's envelope elements and windows, you need to click on the *Quick Envelopes* sub-tab and, making sure that the correct zone is selected using the record selector, define its envelopes and windows, and click on "Create Envelopes". (As this example has excluded additional thermal bridges for simplicity, there is no need to go to the *Envelopes* or *Windows & Rooflights* main tabs afterwards to assign any additional thermal bridges to any envelope element or window).

You should then go to the *Envelope Summary* sub-tab in the *Zones* tab to double-check that you have defined the envelopes correctly. If you have made any errors, you need to go to the *Envelopes* main tab and select and edit the records there.

Finally, you need to go to the *Window & Door Summary* sub-tab in the *Envelope* tab to double-check that you have defined the windows correctly. If you have made any errors, you need to go to the *Windows & Rooflights* tab and select and edit the records there.

7.5.9. Using the reports to double-check the data entry

Apart from the summary sub-tabs already discussed in the previous sections, iSBEM produces two Objects reports which can be used to double-check the data you have entered. For details on these two reports, see Section 7.9: Double-checking the data.

Task 13: Use the Unassigned Objects report and the Data Summary report to double-check your data entry

If you have completed all the tasks up to this point with no errors, you should find that the *Unassigned Objects* Report lists all the zones that you have created listed in the Unassigned Building Objects section.

The *Data Summary* Report should contain only zone z0/01east (one of the 6 zones already defined for you) as this is the only zone that has had its HVAC system selected.

The following section (the *Building Services* form) explains how to assign all the remaining zones in the *Geometry* form to an HVAC system. Only then will they appear in the *Data Summary* Report.

7.6. Building Services form

This form holds all the information relating to the building services. This information is entered into 8 main tabs (these are circled in Figure 46):

- **Global and Defaults** tab – This tab contains some default information on HVAC systems if no or little information is known about the systems in the actual building. It also requires information on the electric power factor and lighting controls for the whole building.
- **HVAC systems** tab - This tab requires information on the HVAC systems in the building.
- **HWS** tab - This tab requires information on the hot water systems in the building.
- **SES** tab - This tab requires information on any solar energy systems connected to the hot water systems in the building, if applicable.
- **PVS** tab – This tab requires information on any photovoltaic systems connected to the building, if applicable.

- **Wind generators** tab – This tab requires information on any wind generators connected to the building, if applicable.
- **CHP generator** tab (this tab only appears when one of the HVAC systems described in the *HVAC Systems* tab is specified as using CHP) – This tab requires information on any combined cooling, heating, and power generators connected to the building.
- **Zones** tab – This is where you assign the appropriate HVAC system and HWS to each zone and input details on the zones' lighting and specific ventilation strategy.

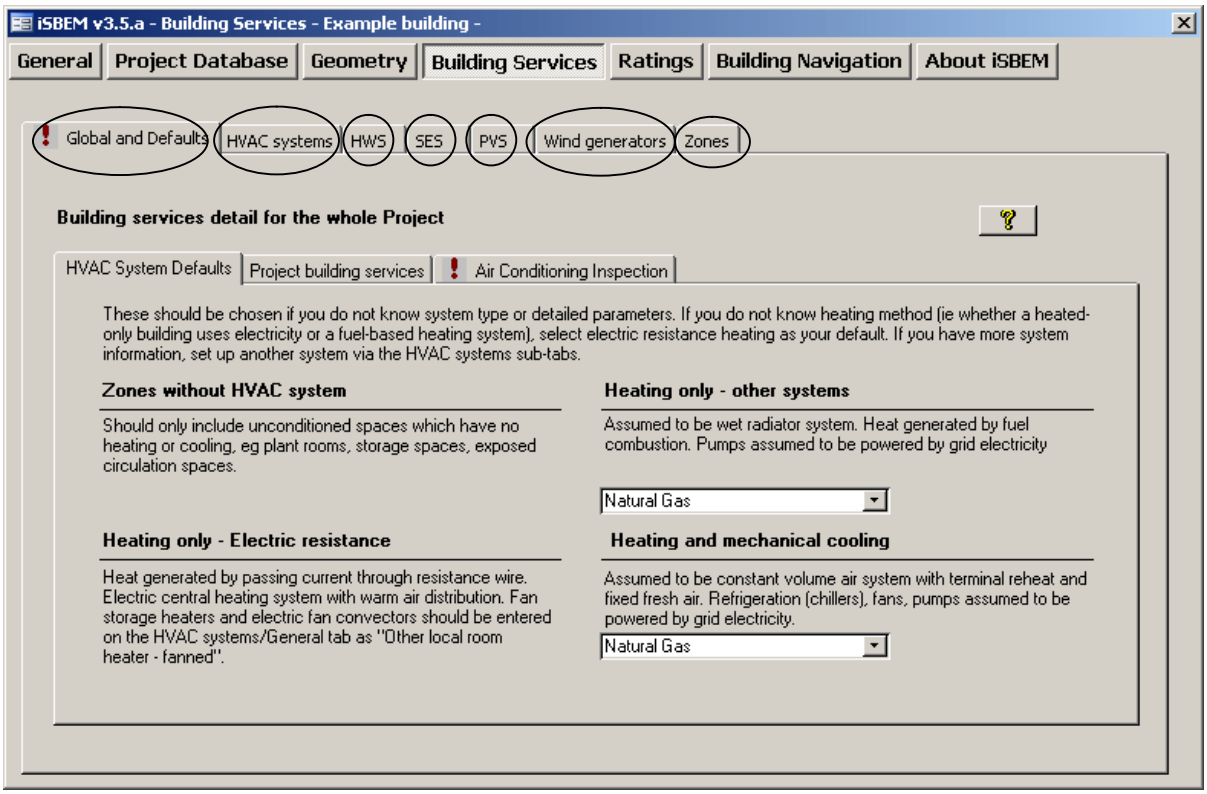

iSBEM v3.5.a - Building Services - Example building -
General
Project Database
Geometry
Building Services
Ratings
Building Navigation
About iSBEM
Global and Defaults
HVAC systems
HWS
SES
PVS
Wind generators
Zones
Building services detail for the whole Project
HVAC System Defaults
Project building services
Air Conditioning Inspection
These should be chosen if you do not know system type or detailed parameters. If you do not know heating method (ie whether a heated-only building uses electricity or a fuel-based heating system), select electric resistance heating as your default. If you have more system information, set up another system via the HVAC systems sub-tabs.
Zones without HVAC system
Should only include unconditioned spaces which have no heating or cooling, eg plant rooms, storage spaces, exposed circulation spaces.
Heating only - other systems
Assumed to be wet radiator system. Heat generated by fuel combustion. Pumps assumed to be powered by grid electricity
Natural Gas
Heating only - Electric resistance
Heat generated by passing current through resistance wire. Electric central heating system with warm air distribution. Fan storage heaters and electric fan convectors should be entered on the HVAC systems/General tab as "Other local room heater - fanned".
Heating and mechanical cooling
Assumed to be constant volume air system with terminal reheat and fixed fresh air. Refrigeration (chillers), fans, pumps assumed to be powered by grid electricity.
Natural Gas

Figure 46: The eight tabs in the Building Services form

7.6.1. Global and Defaults tab

In this tab, there are three sub-tabs:

- **HVAC System Defaults** sub-tab - This sub-tab is visible only if EPC generation is selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab.
- **Project Building Services** sub-tab
- **Air Conditioning Inspection** sub-tab - This sub-tab is visible only if EPC generation (except EPC Scotland) is selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab.

HVAC System Defaults sub-tab:

This sub-tab is visible only if EPC generation is selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab. If no HVAC system serves the space (i.e., an unconditioned zone), you should select the option 'Zones without HVAC system' as the HVAC system for that zone in the *Geometry* form > *Zones* tab > *General* sub-tab (spaces which have no heating or cooling, e.g., plant rooms, storage spaces, exposed circulation

spaces.). If you do not know the type of the HVAC system in your existing building or its detailed parameters, you should instead select one of the following default options from the drop-down menu (see Section 7.5.3: Defining zones – Zones tab):

- 'Heating only - Electric resistance' - Heat generated by passing current through resistance wire. Assumed to be electric central heating system with warm air distribution. Fan storage heaters and electric fan converters should be input by defining an HVAC system in the *Building Services* form > *HVAC Systems* tab > *General* sub-tab and selecting the system type "Other local room heater - fanned". If you do not know the heating method (i.e., whether a heated-only building uses electricity or a fuel-based heating system), you should select electric resistance heating as your default.
- 'Heating only - Other systems' - Assumed to be wet radiator system, heat generated by fuel combustion. Pumps assumed to be powered by grid-supplied electricity. If you know the fuel type used by the heating system, you can define it in this sub-tab (Figure 46).
- 'Heating and mechanical cooling' - Assumed to be constant volume air system with terminal reheat and fixed fresh air. Refrigeration (chillers), fans, and pumps assumed to be powered by grid-supplied electricity. If you know the fuel type used by the heating system, you can define it in this sub-tab (Figure 46).

NB: The default HVAC systems are representative of existing rather than new buildings and should only be used if you do not know the type of the HVAC system in your building or its detailed parameters as the default efficiencies assumed by iSBEM for these systems are quite pessimistic and cannot be edited by the user.

Project Building Services sub-tab:

In this sub-tab, you need to enter details about the electrical power factor and the controls provisions for lighting in the building as shown in Figure 47:

Metering provision for lighting systems

1. Is the lighting separately sub-metered? If you select "Yes", the following question becomes active:
    - M&T with alarm for "out of range" values? – This refers to monitoring and targeting as a means of identifying changes in operation or onset of faults.

The above two parameters on controls corrections are not available if the "Purpose of Analysis" parameter is set to 'Scottish Building Regulations' in the *General* form > *General Information* tab > *Project Details* sub-tab. Instead, the following parameter becomes active:

2. Lighting voltage reduction management scheme? – This parameter is only available under the Scottish Building Regulations. If the input to this parameter is "Yes", a 1% correction factor is applied to the lighting load of the building.

*Building Detail*s

3. Electric power factor – This is a measure of the actual electric power consumption to that usually measured by the electric metre (results from the voltage and current variations being out of phase). Select from: '<0.9', '0.9-0.95', and '>0.95'.

District Heating Parameters

4. Do you know the CO_2 conversion factor of the district heating network? – This parameter is active only if 'District Heating' is selected as the heat source and fuel type for any of the HVAC systems defined in the building. If you select "Yes", then you can enter the value in $kgCO_2/kWh$. Otherwise, a default value will be used.

NB: The CO_2 emission factor for district heating should reflect the average annual efficiency and fuel mix of the whole district heating system. It should include all heat generating plants, including any CHP generators, any waste heat recovery or heat dumping, the effect of heat

losses in distribution (external to the building), the emissions from electricity used for pumping, and any other relevant carbon dioxide emissions. The CO_2 emission factors for the fuel(s) used by the district heating system should be taken from Table 2 of the Approved Document L2A. Submission for Building Regulations compliance and the evidence collected by the EPC energy assessors should include a report signed by a suitably qualified person, detailing how the emission factor for district heating has been derived.

NB: Guidance for calculating the CO_2 emission factor for district heating schemes supplied by Combined Heat and Power only systems (CHP): For CHP systems, the overall CO_2 emission factor is the CO_2 emission factor of the fuel divided by the overall efficiency of the CHP plant. If more than one fuel is used, an average figure is calculated according to the guidance for bivalent systems (see section 7.6.2: Defining HVAC Systems – HVAC Systems tab). This will need to be apportioned between heat and electricity. A suitable method for the purposes of calculations for Building Regulations compliance and Energy Performance Certificates for non-domestic buildings is to use the following equations[x].

OEF = Overall CO_2 emission factor as defined above

HPR = the heat to power ratio over the whole year

CO_2 emission factor for heat: = OEF x (HPR + 1) / (2.5 + HPR)

CO_2 emission factor for electricity: = OEF x (HPR + 1) / (0.4 + HPR)

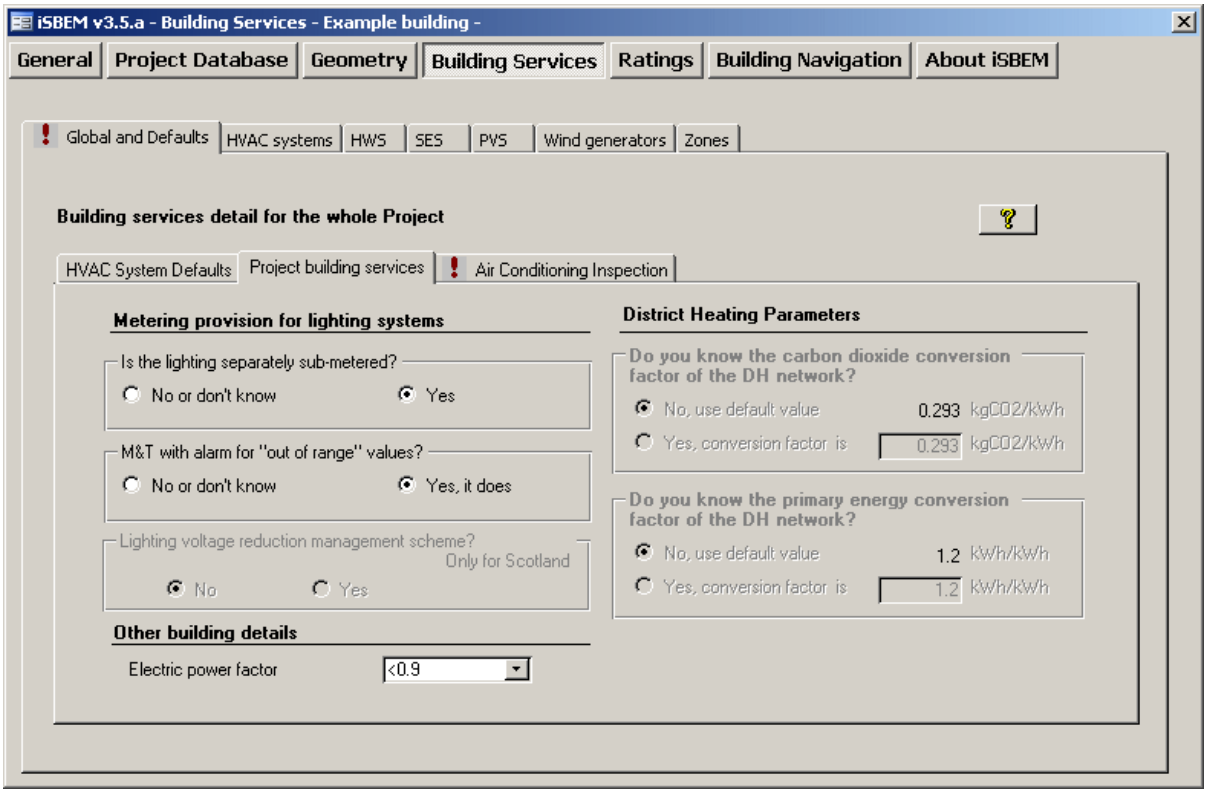


Figure 47: Project Building Services sub-tab of the Global and Defaults tab in the Building Services form

[x] These apply the method recommended in C. Pout, R. Hitchin, Apportioning Carbon emissions from CHP Systems, Energy Conversion and Management 46(2005) using the CO2 emission factors for natural gas and grid-displaced electricity from ADL2A.

Air Conditioning Inspection sub-tab:

This sub-tab is visible only if EPC generation (except EPC Scotland) is selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab. In this sub-tab, you need to enter details about the air conditioning system in the building, if applicable, as shown in Figure 47. This data is used by SBEM purely for reporting purposes (in the XML file for lodgement) and is not used during the calculation.

1. Tick box to indicate if the building has an air conditioning system. If the box is ticked, the following parameters become active:

   a) Tick box to indicate if the total effective rated output of the air conditioning system is known.

   - If the actual output is known, the box should be unticked, and the value should be entered, in kW, into the box, which becomes active. Further guidance can be accessed by clicking on the adjacent ? button.
   - If the actual output is unknown, the box should be ticked, and a value for an estimated range should be selected from the options in the drop-down menu, which becomes active. Further guidance can be accessed by clicking on the adjacent ? button.

   b) Has an air conditioning inspection been commissioned for compliance with Energy Performance of Buildings Regulations – Select an option from the drop-down menu.

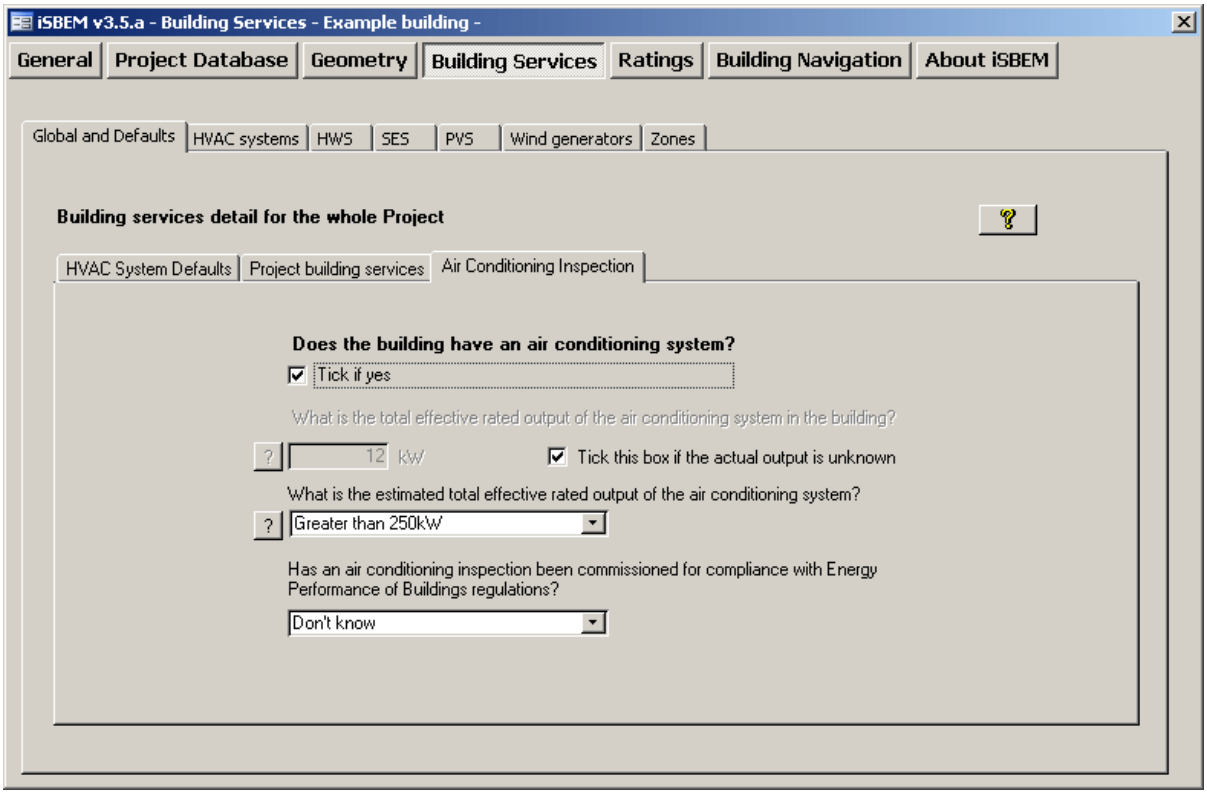

iSBEM v3.5.a - Building Services - Example building -
General
Project Database
Geometry
Building Services
Ratings
Building Navigation
About iSBEM
Global and Defaults
HVAC systems
HWS
SES
PVS
Wind generators
Zones
Building services detail for the whole Project
HVAC System Defaults
Project building services
Air Conditioning Inspection
Does the building have an air conditioning system?
Tick if yes
What is the total effective rated output of the air conditioning system in the building?
12 kW
Tick this box if the actual output is unknown
What is the estimated total effective rated output of the air conditioning system?
Greater than 250kW
Has an air conditioning inspection been commissioned for compliance with Energy Performance of Buildings regulations?
Don't know

Figure 48: Air Conditioning Inspection sub-tab of the Global and Defaults tab in the Building Services form

7.6.2. Defining HVAC Systems – HVAC Systems tab

Overview of how to model HVAC Systems

The building's HVAC system(s) is defined within the first six sub-tabs of the *HVAC systems* tab.

- **General** sub-tab: This is where you select the system type, give it a unique name, and enter some basic system details for each HVAC system in the building.
- **Heating** sub-tab: This is where you can further define the heat generator efficiency.
- **Cooling** sub-tab: This is where you can further define the cold generator efficiency.
- **Systems Adjustments** sub-tab: This is where details on air leakage and specific fan power can be entered.
- **Metering Provision (renamed from Control Corrections)** sub-tab: This is where details of the metering provision for the HVAC system can be defined.
- **System Controls** sub-tab: This is where heating system controls can be defined. This sub-tab is visible only if EPC generation is selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab.
- **Zone Summary** sub-tab: This tab displays a summary of the zones assigned to the HVAC system, along with the zones' envelopes, windows, and doors.

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The ***System type*** selected in the *General* sub-tab automatically brings with it some assumptions. For example, whether mechanical ventilation is an integral part of the system and the degree of local time and temperature control that is (or can be) provided. The majority of system types used in UK buildings can be found in the system type drop-down box. However, there are a few systems which require further guidance, such as:

- VRF with natural ventilation – Select 'Split or multi-split system', and then adjust the efficiencies in the *Heating* and *Cooling* sub-tabs to values suitable for the VRF.
- VRF with mechanical ventilation – Select 'Split or multi-split system', and then adjust the efficiencies in the *Heating* and *Cooling* sub-tabs to values suitable for the VRF, and define mechanical ventilation at zone level.
- If 'Chilled ceiling' is selected, the default assumption is that there is displacement ventilation.
    - Chilled ceiling with no mechanical ventilation – Select 'Chilled ceilings or passive chilled beams and displacement ventilation', and then set the specific fan power to zero.
    - Chilled ceiling with mixing ventilation – Select 'Chilled ceilings or passive chilled beams and displacement ventilation', and then use twice the actual specific fan power in order to capture the effect of the higher ventilation rate.
- If your HVAC system is a high velocity forced-convection air heating (induction nozzle system), which does the job of mixing the air in the zone in a similar manner to destratification fans, then you can model this in iSBEM by first selecting the appropriate HVAC system type (flued or unflued) and then ticking the above box relating to destratification fans in the zones served by that system. The system should follow the flow rate guidelines given for destratification systems shown below. You will then need to justify this to Building Control using the necessary documentation for your system's functions.

NB: Destratification may be achieved by several means, for each of which minimum flow rates should be ensured. (Where destratification and heating is provided by the same system, higher flow rates may be needed to avoid excessive air supply temperatures):

- Cased fans installed at high level. The volume of air handled by the fans should be at least equivalent to two room volumes per hour. Total air movement will be higher than this because additional airflow will be induced.
- Open blade “sweep fans”. In this case, air speeds will be lower and the volume of air handled should be at least the equivalent of 6 room volumes per hour.
- High velocity induction nozzles with a temperature rise through the heater of at least 45˚C. The volume of primary air from the nozzles should be at least equivalent to 0.15 room volumes per hour. Total air movement will be significantly higher because of the additional airflow induced by the nozzles.

The system type, along with the further details entered in the remaining four HVAC sub-tabs, allow SBEM to calculate the System Seasonal Efficiency for heating (SSEFF), the System Seasonal Energy Efficiency Ratio for cooling (SSEER), and the Auxiliary Energy. For further details on these parameters and how they are calculated, see the Non-Domestic HVAC Compliance Guide[xi].

SSEFF – The System Seasonal Efficiency for heating takes account of the seasonal efficiency of the heat generator, thermal losses and gains to and from pipework and ductwork, and duct leakage. It does not include the energy used by fans and pumps. The combined heating demand of all zones served by a particular system divided by its SSEFF gives the energy consumption of the heating system (For example, a boiler or boilers).

SSEER – The System Seasonal Energy Efficiency Ratio for cooling takes account of the seasonal efficiency of the cold generator, thermal losses and gains to and from pipework and ductwork, and duct leakage. It does not include the energy used by fans and pumps. The combined cooling demand of all the zones served by a particular system divided by its SSEER gives the energy consumption of the cooling system (For example, a chiller).

Auxiliary Energy – This is applied to the total floor area conditioned by a particular system. It depends on the duration of occupation and operation in the zones served, and it covers the energy used by fans, pumps, and controls. The calculation depends on the HVAC system type selected, as well as on other information provided by the user on the SFP, duct and AHU leakage, and control provision.

If no HVAC system serves the space (i.e., an unconditioned zone), you should select the option ‘Zones without HVAC system’ as the HVAC system for that zone in the *Geometry* form > *Zones* tab > *General* sub-tab (spaces which have no heating or cooling, e.g., plant rooms, storage spaces, exposed circulation spaces). If you do not know the type of the HVAC system in your existing building or its detailed parameters, you should instead select one of the following default options from the drop-down menu (see Section 7.5.3: Defining zones – Zones tab):

- ‘Heating only - Electric resistance’ - Heat generated by passing current through resistance wire. Assumed to be electric central heating system with warm air distribution. Fan storage heaters and electric fan converters should be input by defining an HVAC system in the *Building Services* form > *HVAC systems* tab > *General* sub-tab and selecting the system type "Other local room heater - fanned" (see below). If you do not know the heating method (i.e., whether a heated-only building uses electricity or a fuel-based heating system), you should select electric resistance heating as your default.
- ‘Heating only - Other systems’ - Assumed to be wet radiator system, heat generated by fuel combustion. Pumps assumed to be powered by grid-supplied electricity. If you know the fuel type used by the heating system, you can define it in this sub-tab (Figure 46).
- ‘Heating and mechanical cooling’ - Assumed to be constant volume air system with terminal reheat and fixed fresh air. Refrigeration (chillers), fans, and pumps assumed

[xi] The Non-Domestic Heating, Cooling, and Ventilation Compliance Guide published by the CLG.

to be powered by grid-supplied electricity. If you know the fuel type used by the heating system, you can define it in this sub-tab (Figure 46).

NB: The default HVAC systems are representative of existing rather than new buildings and should only be used if you do not know the type of the HVAC system in your building or its detailed parameters as the default efficiencies assumed by iSBEM for these systems are quite pessimistic and cannot be edited by the user.

General sub-tab:

The *General* sub-tab is shown in Figure 49. For each HVAC system in your building, you will need to create a new record and add the following information:

1. Name – A unique name must be given to each HVAC system.

NB: Note that the 'Multiplier' field no longer exists for HVAC systems (or HWS. If you convert project files created with previous versions of the tool, where this field had a value of more than 1, corresponding multiples of the zones served by that HVAC system are created.

2. System type – Here, you can currently choose between 26 system types (11 heating only systems and 15 heating and cooling systems), including, for e.g., VAV (variable air volume), fan coil, dual duct, and central heating with water distribution (see Table 13 for brief definitions of the system types).

NB: In order to ensure adequate ventilation for maintaining the concentration of CO_2 below 0.5% in spaces served by unflued heating appliances[xii], the zonal ventilation option for these spaces should be set to 'mechanical' (See section 7.6.8: Defining the zone specific building services).

NB: In iSBEM version v2.0.b onwards, changes were made to the HVAC system options. "Variable refrigerant flow" (VRF) systems and "Split or multi-split system with ventilation" systems have been removed from the options available in iSBEM for HVAC system types, and for these systems, users should now select "Split or multi-split system", with a suitable efficiency. This change was made in order to simplify the HVAC system options (multisplit can be used for VRF as VRF is a type of split/multisplit system) and in order to remove ventilation from HVAC systems where the ventilation is not an integral part of the system heating/cooling strategy. Using v2.0.b or later, if these systems are accompanied by mechanical ventilation, mechanical ventilation should now be defined at zone level with a suitable ventilation SFP.

NB: Zonal ventilation is no longer available for fan coil units. Ventilation for this HVAC type is defined at HVAC level. See note after *System Adjustments* sub-tab, regarding specific fan power for fan coil systems.

NB: See note in Section 7.6.8: Defining the zone specific building services, regarding defining high velocity forced-convection warm air heaters.

NB: If there is **more than one type of HVAC system in a space** with each system clearly meant to service a particular part of the space, e.g., one servicing the facade perimeter area and another servicing the core area, then the space should be divided into 2 separate zones in iSBEM (each served by its corresponding HVAC system) even if there is no physical separation between the 2 zones. However, if heating is provided in the same zone by two, or more, different types of heat sources, for e.g., a heat pump in a split system and a gas boiler in a wet system, you need to calculate (and enter into iSBEM) a seasonal heat generating efficiency which is equivalent to both these heat sources based on their respective efficiencies, fuel types, and loads, as described in the guidance on the bivalent calculation later in this section. On the other hand, if a zone is served by, for e.g., a gas-fired wet system for heating and an electric split system for cooling only, then the systems can be approximated in SBEM by defining your HVAC system type as "split or multisplit", the heat source as "LTHW boiler", and fuel type as "natural gas", and then define the appropriate seasonal efficiency for the heating and energy efficiency

[xii] For details, please refer to BS 5925:1991: Code of Practice for Ventilation Principles and Designing for Natural Ventilation.

ratio for the cooling. SBEM will use natural gas for the heating and grid-supplied electricity for the cooling. If applicable, you then need to define the mechanical ventilation at zone level (for all the zones served by this system) with a suitable ventilation SFP, and heat recovery.

If you change the HVAC system type defined in your project from one that provides mechanical ventilation to one that does not (or vice versa), you must re-visit the Ventilation sub-tab of the Zones tab in the Building Services form for all the zones served by this HVAC System in order for all ventilation-related parameters to be updated by the tool. You may also wish to re-define whether the ventilation is natural or mechanical in these zones following the change in the HVAC type (see Section 7.6.8: Defining the zone specific building services- Zones tab).

Heating system:

3. Heat source – Depending on the system type selected, a selection of heat sources is offered. For example, if 'Single-duct VAV' is selected, you need to choose between: LTHW boiler, MTHW boiler, HTHW boiler, Direct or storage electric heater, Heat pump: air source, Heat pump: ground or water source, and District heating.
4. Fuel type – Depending on your selected heat source, you will be given a selection of heating fuel types to choose from, for e.g., Natural gas, LPG, Oil, Grid-supplied electricity.
5. Tick if this system also uses CHP (tick box) – This tick box appears if the system type selected can use CHP. If it is ticked, a new tab appears, *CHP generator*, where further details are required to describe the CHP facility. If the box is not ticked, the tab does not appear.

Cooling system:

6. Generator type - If appropriate to your choice of system, you will be given the option to select a cooling generator type from the drop-down list: Air cooled chiller, Water cooled chiller, Remote condenser chiller, Heat pump (gas/oil), or Heat pump (electric).

Ventilation:

7. Heat recovery – Depending on the system type, this ventilation characteristic needs to be selected from: No heat recovery, Plate heat exchanger (Recuperator), Heat pipes, Thermal wheel, and Run around coil (see Table 12).

Option	Brief Definition
No heat recovery	No heat recovery system
Plate heat exchanger (Recuperator)	Recuperators usually take the form of air-to-air plate heat exchangers
Heat pipes	The heat-pipe is a passive heat exchanger of which there are two main types: • horizontal - in which a wick within the tubes transfers liquid by capillary action • vertical - in which heat from the warmer lower duct is transferred to the cold upper duct by means of a phase change in the refrigerant.
Thermal wheel	A thermal wheel comprises a cylinder packed with a suitable heat transfer medium that rotates slowly within an airtight casing which bridges the ducts between which heat is to be transferred.
Run around coil	Finned air-to-water heat exchangers are installed in the ducts between which the heat is to be transferred. A pumped water or water/glycol (for freeze protection) circuit is used to transfer heat from the warm extract air to the cooler supply air (or vice versa in summer)

Table 12: Definitions of heat recovery options in iSBEM

8. Heat recovery seasonal efficiency - This parameter is active if a heat recovery system is selected, i.e., the previous parameter is not set to 'No heat recovery'. If you know the heat recovery efficiency, it can be introduced manually into the interface. Otherwise, a default value, corresponding to the selected heat recovery system type, will be used by SBEM.

NB: If the SFP was calculated or measured for a mechanical ventilation system that already included heat recovery, then that is the value you enter into iSBEM. If the SFP was calculated or measured for a mechanical ventilation system before a heat recovery system was added on, then you need to add 0.15 to the SFP for a thermal wheel system, and 0.3 for any of the other heat recovery options in iSBEM, to account for the additional resistance.

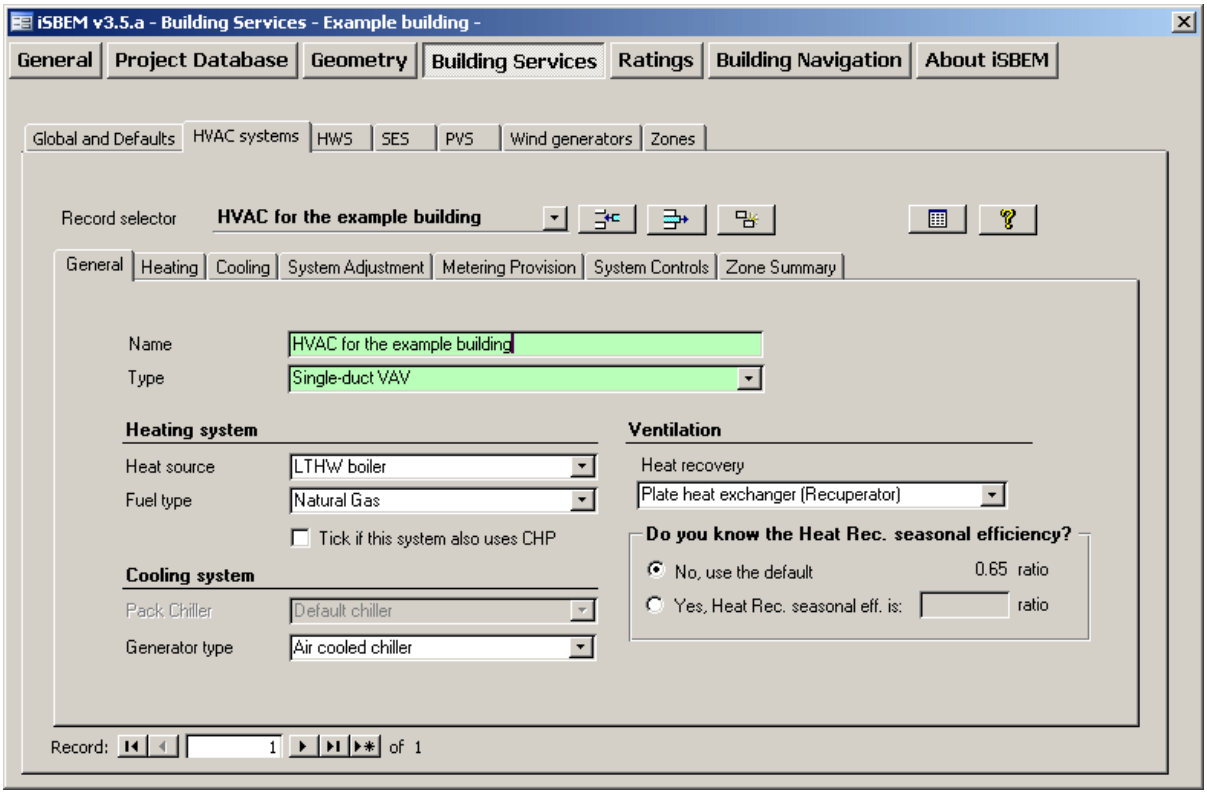


Figure 49: HVAC system definition, General sub-tab

System Type in iSBEM	Brief Definition
Central heating using water: radiators	Central heat generator(s) with water distribution and radiators
Central heating using water: convectors	Central heat generator(s) with water distribution and convectors
Central heating using water: floor heating	Central heat generator(s) with water distribution and floor heating
Central heating with air distribution	Central heat generator(s) with air distribution
Other local room heater - fanned	Includes gas fires, gas convectors, direct electric heaters, electric storage heaters that are provided with fans. Larger units above about 10kW such as "cabinet heaters" or "unit heaters" should be classed as "forced convection air-heaters"
Other local room heater - unfanned	Includes gas fires, gas convectors, direct electric heaters, electric storage heaters that do not have fans

Unflued radiant heater	Luminous or non-luminous overhead radiant heater without flue. Includes electric overhead radiant heaters
Flued radiant heater	Luminous or non-luminous overhead radiant heater with flue
Multiburner radiant heaters	Overhead multiburner radiant heater
Flued forced-convection air heaters	May have fan to assist transportation of combustion air and/or combustion products. The 'Auxiliary energy for fanned warm air heaters' parameter becomes active within the *System Adjustment* sub-tab
Unflued forced-convection air heaters	"Direct" gas heaters. The 'Auxiliary energy for fanned warm air heaters' parameter becomes active within the *System Adjustment* sub-tab. Note that provision for adequate ventilation must be provided
Single-duct VAV	An all-air system in which the volume of supply air is modulated to match the cooling demand. May have reheat capability. Assumed to also provide heating, possibly also with separate perimeter heating system
Dual-duct VAV	A VAV system with separate supply of hot and cold air. Assumed to also provide heating, possibly also with separate perimeter heating system
Indoor packaged cabinet (VAV)	Local cooling/heating unit. May supply air directly into room, into under floor void, or into ceiling void. May have terminal units with variable local recirculation rate. May have electrical trim heater. Volume of air handled is sufficient to handle all the cooling load. Assumed to also provide heating, possibly also with separate perimeter heating system
Fan coil systems	Local fanned terminal units in ceiling, on wall or on floor, with a central chilled water supply. Systems may be 2-pipe, 3-pipe or 4-pipe, changeover or non-changeover - no distinction is made here. Assumed to also provide heating. Zonal ventilation is no longer available for fan coil units. Ventilation for this HVAC type is defined at HVAC level.
Induction system	Air is supplied from a central unit, commonly at high pressure. This induces a secondary airflow within the terminal unit to achieve an acceptable delivery temperature. Final heating or cooling is provided by heat exchangers within the terminal. Systems may be 2-pipe, 3-pipe or 4-pipe, changeover or non-changeover - no distinction is made here. Assumed to also provide heating.
Constant volume system (fixed fresh air rate)	An all-air system in which the volume of supply air is fixed. Assumed to also provide heating, possibly also with separate perimeter heating system. If provided with local reheat capability, use the "Terminal reheat (constant volume)" system. This category includes packaged rooftop units.
Constant volume system (variable fresh air rate)	Constant volume system in which the proportion of fresh air can be varied to limit chiller operation ("free cooling economiser").

Multizone (hot deck/cold deck)	A central air handling unit has separate hot and cold decks. Mixing takes place at the Air handling unit and air is supplied to each zone through a single duct per zone. Assumed to also provide heating, possibly also with separate perimeter heating system.
Terminal reheat (constant volume)	Cooled air is supplied centrally and reheated locally to the desired supply temperature for each zone. Assumed to also provide heating, possibly also with separate perimeter heating system.
Dual duct (constant volume)	Hot and cold air are distributed separately - commonly at high pressure - and locally mixed to provide the desired supply temperature for each zone. Assumed to also provide heating, possibly also with separate perimeter heating system.
Chilled ceilings or passive chilled beams and displacement ventilation	The combination of a chilled ceiling (or passive chilled beam) system with a separate low-level, low volume supply of cooled ventilation air. Heating assumed to be by separate LTHW system. The default assumption is that there is displacement ventilation.
Active chilled beams	Chilled beams which include the provision of cooled air from a central source, typically operating as an induction system. May include local fans. Heating assumed to be by separate LTHW system.
Water loop heat pump	Local heat pumps are served by a common water circuit to or from which they can reject or extract heat. Central cooling and heating plant provides the net heat or cooling input to this circuit. Assumed to also provide heating.
Split or multi-split system	Combination of outdoor and indoor units connected by refrigerant pipe work. No mechanical ventilation system. Use this category also for ducted split systems and window/wall units. *The SEER/SCoP should include the power consumption for compressors, controls, as well as fans and pumps within the air-conditioning units.*
Single room cooling system	Integral units without ducting, such as wall or window units. Ducted units should be defined as constant or variable volume air systems, as appropriate. *The SEER/SCoP should include the power consumption for compressors, controls, as well as fans and pumps within the air-conditioning units.*

Further guidance

Further guidance

Table 13: Definitions of HVAC type options in iSBEM

Heating sub-tab:

Once you have entered the basic information on each HVAC system into the *General* sub-tab, there are a few more details on the heating efficiency which can be entered, if they are known. You will see that the 'Heat Source' and 'Fuel Type' fields that were completed in the *General* tab also appear in this tab (they can be edited in either tab).

First, you need to select the HVAC system with the record selector, and then the following information can be entered:

Heating System

1. Heat source – Depending on the system type selected, a selection of heat sources is offered. For example, if 'Single-duct VAV' is selected, you need to choose between: LTHW boiler, MTHW boiler, HTHW boiler, Direct or storage electric heater, Heat pump: air source, Heat pump: ground or water source, and District heating.
2. Fuel type – Depending on your selected heat source, you will be given a selection of heating fuel types to choose from, for e.g., Natural gas, LPG, Oil, Grid-supplied electricity.
3. Tick if this heating system uses variable speed pumps (tick box) – This tick box appears only if the system type selected is central heating using water. If it is ticked, variable speed pumping will be considered during the calculation of the auxiliary energy.
4. Effective heat generating seasonal efficiency - If you know the effective heat generating seasonal efficiency for the heat generator, it can be introduced manually into the interface. Otherwise, a default value will be used by SBEM.

NB: The Effective Heat Generating Seasonal Efficiency is calculated by adding the Heating Efficiency Credits, where applicable, to the Heat Generator Seasonal Efficiency. The Heat Generator Seasonal Efficiency is the ratio of the useful heat output to the energy input over the heating season. The Heating Efficiency Credits are available for additional controls and other measures that go beyond the required minimum controls package. Details of the minimum controls packages for the different systems, additional controls, and corresponding available credits are in the Non-Domestic Heating, Cooling, and Ventilation Compliance Guide published by CLG[xiii]. Note that the necessary documentation to support the efficiency calculation may be required by Building Control.

- The default value is based on whether the generator is on the Energy Technology List (ETL) of the 'Enhanced Capital Allowance' (ECA) scheme[xiv]. If not, you then need to select whether the generator was installed in or after 1998.

NB: For boiler systems installed from 1998 onwards, a default seasonal efficiency of 0.81 is suggested by the tool (based on Statutory Instrument 1994 No. 3083), and for boiler systems installed before this period, a conservative default seasonal efficiency of 0.65 is suggested. Please note that from around 1989, the boiler industry began producing boilers with efficiencies that would have complied with the above statutory instrument.

Further guidance

Convention: Convention for EPCs - Electric room heaters

Any form of fanned or unfanned electric 'room heater' whether panel, bar, convector or storage heater shall have a user-input heat generating seasonal efficiency of 1 (i.e., 100% efficiency).

2. Generator radiant efficiency (this parameter is active if the HVAC system chosen is a radiant system) - It refers to the ratio of radiant heat output to energy input. If you know the generator's radiant efficiency, it can be introduced manually into the interface. Otherwise, a default value will be used by SBEM.

- The default value is based on whether or not the generator is on the Energy Technology List (ETL) of the ECA.

Figure 50 shows a heating system being defined.

[xiii] Available from (http://www.planningportal.gov.uk/uploads/br/BR_PDF_PTL_NONDOMHEAT.pdf)
[xiv] www.eca.gov.uk/etl/

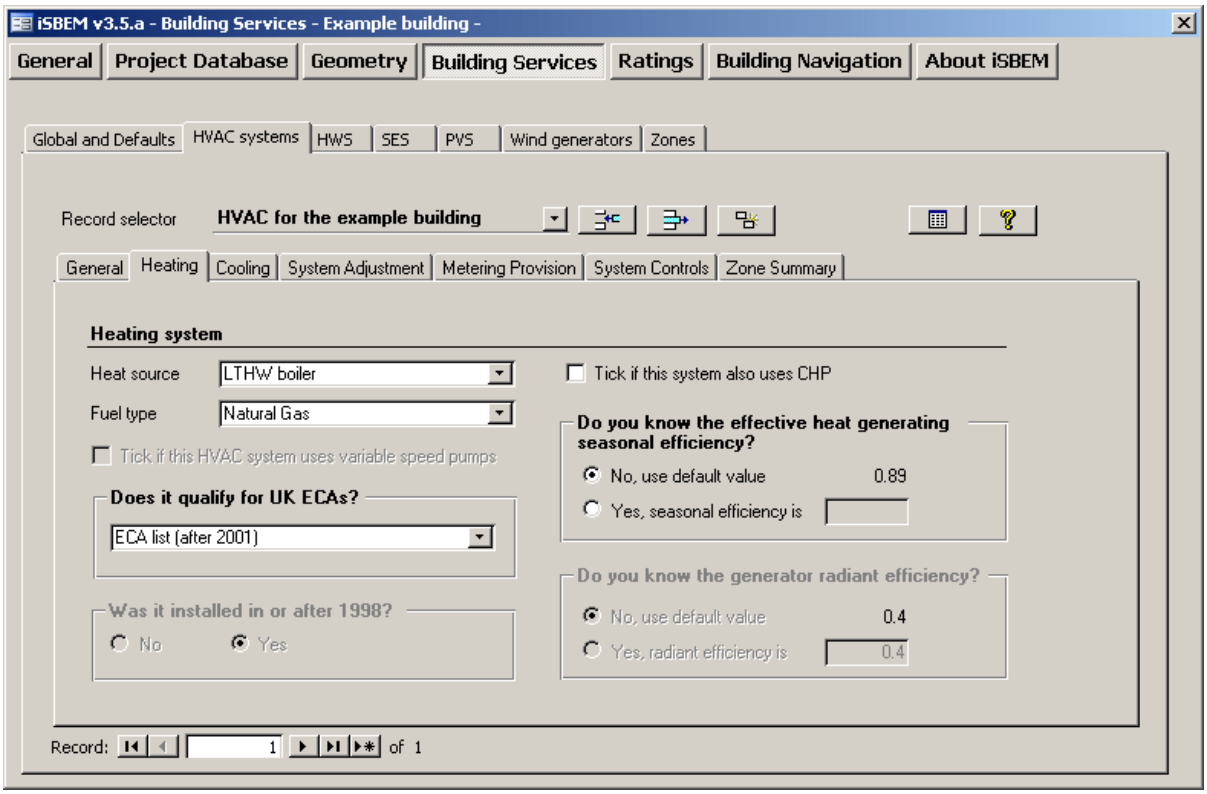


Figure 50: HVAC systems definition, Heating sub-tab

NB: Defining a bivalent system in iSBEM: A bivalent heating system is one in which the heating is supplied by two different types of heat sources. An example could be a heat pump with a gas boiler for backup. Within iSBEM, a fuel type and a seasonal efficiency have to be input in order for the SBEM calculation to produce the overall CO_2 emissions per kWh of the total heating provided by the two heat sources. First, the proportion of the heating demand met by each heat generator needs to be estimated, in a manner that can be justified to Building Control. Then, an efficiency equivalent to the 2 systems based on their respective loads, efficiencies, and emission factors (obtained from ADL2A) needs to be calculated. Also, in order to ensure that the notional building is correctly defined (according to definition in ADL2A), if the fuel of one of the 2 generators is gas, it is necessary to define the fuel type for the equivalent heating system, which is entered into iSBEM, as gas (for more guidance on the notional building fuel, please refer to section 2.2: Calculation basics for UK Building Regulations compliance purposes). Even if the calculated equivalent efficiency figure in this case is over 100%, this is just an artificial value for a "virtual" boiler needed to produce the correct carbon emissions in the SBEM calculation. If gas is not used in the building, the heating fuel should be defined as the fuel used by the heat source with the majority of the load. Therefore, for example, if a heating system uses a heat pump of COP 3 providing 75% of the annual heating demand, and the remaining 25% of demand is met by a natural gas boiler of 85% efficiency (the CO_2 emission factor for grid-supplied electricity is 0.422 $kgCO_2/kWh$ and for natural gas is 0.194 $kgCO_2/kWh$), the heating fuel type is entered as natural gas into iSBEM, and the equivalent efficiency can be calculated as follows:

$$SEff_{equivalent} = \frac{EmissionFactor_{Gas}}{\left(\frac{EmissionFactor_{Elec}}{COP_{HeatPump}} \times Load_{HeatPump}\right) + \left(\frac{EmissionFactor_{Gas}}{SEff_{Boiler}} \times Load_{Boiler}\right)}$$

$$SEff_{equivalent} = \frac{0.194}{\left(\frac{0.422}{3} \times 0.75\right) + \left(\frac{0.194}{0.85} \times 0.25\right)} = 1.193$$

Further guidance

N.B. Although natural gas and grid electricity were used as examples to explain the above bivalent calculation (which need to be replaced with the fuels used in any particular bivalent combination), it is important that the crucial detail which decides the fuel that should be used by SBEM for the notional building is not lost, for e.g., if natural gas is used anywhere in the building or if the majority of the thermal output is provided by a LZC technology. Please refer to Section 2.2: Calculation basics for UK Building Regulations compliance purposes, regarding the factors affecting the notional fuel.

Cooling sub-tab:

In addition to the information entered in the *General* sub-tab, you can define the power rating and efficiency of the cooling system. If they are not known, default values will be used by the software. The information is entered as follows:

Cooling System

1. Generator type - If appropriate to your choice of system, you will be given the option to select a cooling generator type from the drop-down list: Air cooled chiller, Water cooled chiller, Remote condenser chiller, Heat pump (gas/oil), or Heat pump (electric).
2. Generator kW – This is the cooling generator's nominal electrical power, and if applicable, it needs to be selected from: Up to 100kW, 101 to 500kW, 501 to 750kW, and 751 to 3.5MW. This field is not active if the cooling generator type selected is Heat pump (gas/oil), or Heat pump (electric).
3. Fuel type – Depending on your selected cooling generator type, you will be given a selection of cooling fuel types to choose from, for e.g., Natural gas, LPG, Biogas, Oil, or Grid-supplied electricity.
4. Seasonal energy efficiency ratio - If you know the seasonal energy efficiency ratio (SEER) for the cooling generator, it can be introduced manually into the interface. Otherwise, a default value will be used by SBEM. (Guidance on the calculation of the seasonal energy efficiency ratio can be found in the Non-Domestic HVAC Guide published by CLG.)
    - The default value is based on whether or not the chiller or air-conditioner is on the Energy Technology List (ETL) of the 'Enhanced Capital Allowance' (ECA) scheme.
5. Nominal energy efficiency ratio - If you know the nominal energy efficiency ratio (EER) for the cooling generator, it can be introduced manually into the interface. Otherwise, a default value will be used by SBEM for compliance checking. (Guidance on the nominal energy efficiency ratio can be found in the Non-Domestic HVAC Guide published by CLG.)
    - The default value is based on whether or not the chiller or air-conditioner is on the Energy Technology List (ETL) of the ECA.

NB: The cooling generator seasonal energy efficiency ratio is the value used within SBEM to calculate the cooling energy while the cooling generator nominal energy efficiency ratio is the value used for compliance checking in BRUKL with the limiting standards from the HVAC compliance Guide.

6. Tick box to indicate if the HVAC system has mixed mode operation strategy.

NB: "Mixed-mode" refers to a hybrid approach to space conditioning that uses a combination of natural ventilation from operable windows, and mechanical systems that include air distribution equipment and refrigeration equipment for cooling. A mixed-mode building integrates the use of air-conditioning when and where it is necessary, with the use of natural ventilation whenever it is feasible or desirable, to maximize comfort while reducing the energy use (compared to year-round air conditioning).

Further guidance

Convention: Convention for EPCs - Variable speed pumps other than for central heating system using water

The convention is that the effect of variable speed pumps is ignored, pending revision to allow them to be modelled.

Figure 51 shows a cooling system being defined.

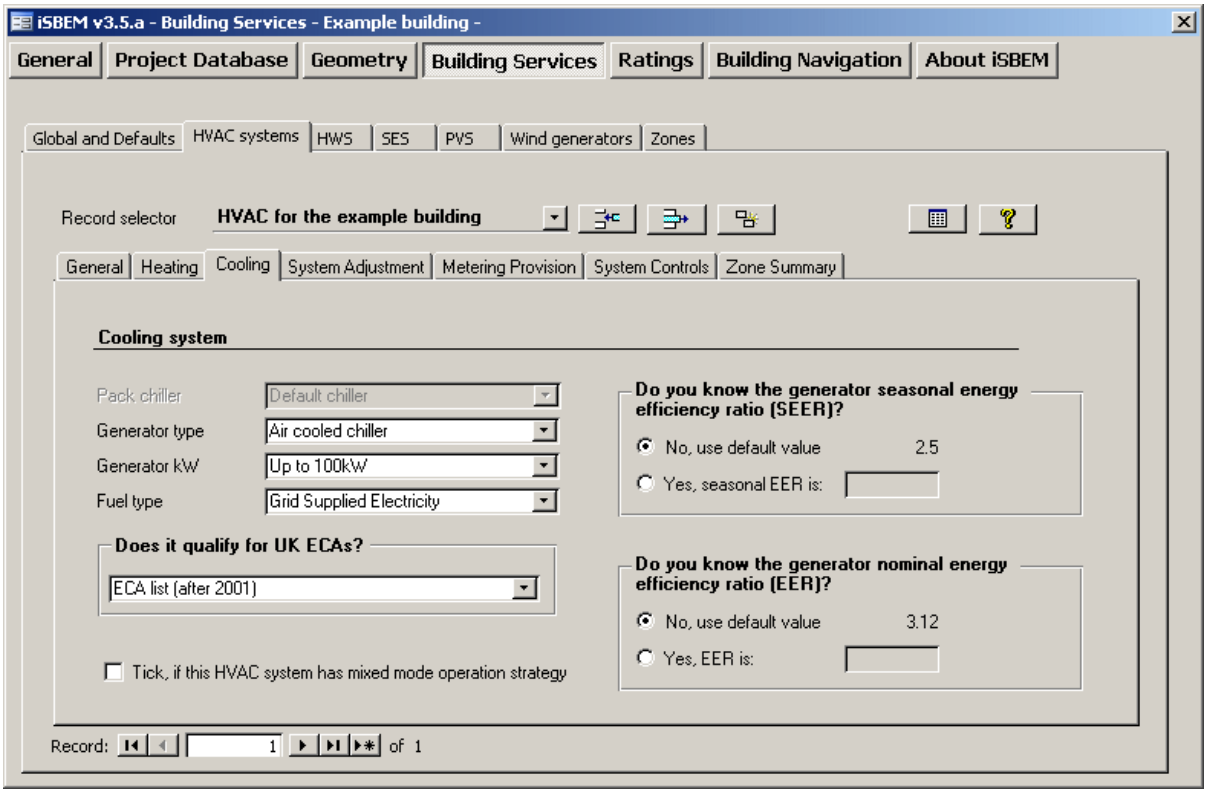


Figure 51: HVAC systems definition: Cooling sub-tab

System Adjustments sub-tab:

The *System Adjustments* sub-tab (Figure 52) allows the user to specify other system properties, such as, the air leakage associated with the ducts or the air handling unit (AHU) and the specific fan power (SFP). If this information is not known, default values will be used by the software.

NB: These default values reflect past practices and may not be compliant with the current Building Regulations.

The information is entered as follows:

Ductwork and AHU Leakage

1. Ductwork leakage – If the ductwork has been tested or design targets set for the building, the appropriate CEN classification for air leakage can be entered by clicking on the radio button “Yes, it meets the CEN leakage classification below” and choosing from the drop-down list between: Class A, Class B, or Worse than Class A. Different classes refer to the maximum air leakage obtained for the HVAC ductwork at different test conditions.
2. AHU leakage – Similarly, if the AHU has been tested or design targets set for the building, click on the appropriate radio button and choose from the drop-down list between: L1, L2, L3, or Worse than L3.

Specific Fan Power for the System

3. Specific Fan Power (SFP) – The SFP of an air distribution system is defined as the sum of the design total circuit-watts, including all losses through switchgear and controls such as inverters, of the fans in the system that supply air and extract it back outdoor (i.e. the sum of the total circuit-watts of supply and extract fans), divided by the design air flow rate through the system. For further details on the SFP and how it is calculated, see the Non-Domestic HVAC Compliance Guide. If the SFP for the system is known, it can be entered manually. Otherwise, the software will insert a default value.

NB: The default value does not comply with the 2006 Building Regulations and should be changed for new buildings.

NB: If the SFP was calculated or measured for a mechanical ventilation system that already included heat recovery, then that is the value you enter into iSBEM. If the SFP was calculated or measured for a mechanical ventilation system before a heat recovery system was added on, then you need to add 0.15 to the SFP for a thermal wheel system, and 0.3 for any of the other heat recovery options in iSBEM, to account for the additional resistance.

NB: Zonal ventilation is no longer available for fan coil units. Ventilation for this HVAC type is defined at HVAC level. The auxiliary energy figures for fan coil systems include an allowance for the fans in the units (there is a minimum acceptable performance figure in the HVAC guide of 0.8 W/(l/s) based on the average of all fan coils). Hence, if the fan coil system is selected as the HVAC system, the SFP input by the user should be for the central plant, and the fan coil allowance will be included automatically.

If the type of HVAC system selected in the *General* sub-tab is a fanned warm air heater (flued or unflued), then the following parameter becomes active:

Auxiliary Energy for Fanned Warm Air Heaters

4. Auxiliary energy for fanned warm air heaters - If the auxiliary energy ratio (auxiliary energy in kWh per kWh of heating energy) for the system is known, it can be entered manually. Otherwise, the software will use a default value.

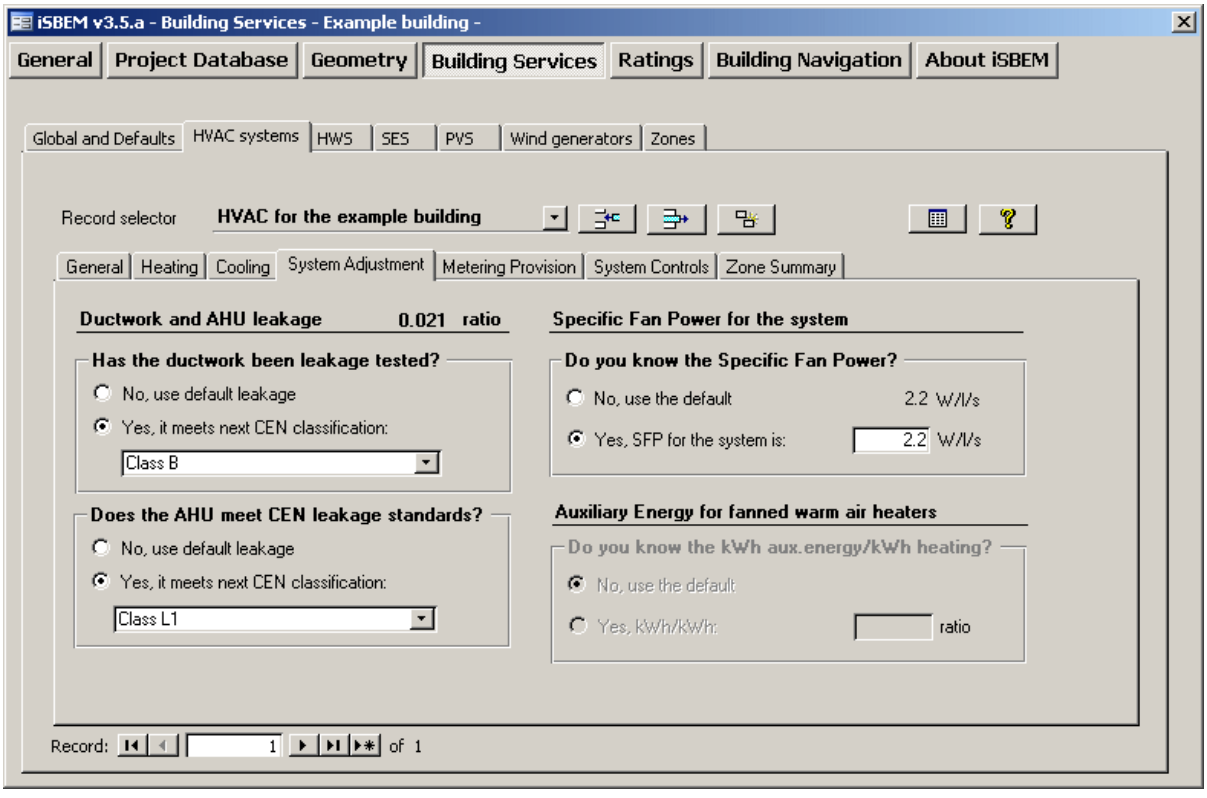


Figure 52: HVAC systems definition: System Adjustments sub-tab

Metering Provision (renamed from Control Corrections) sub-tab:

The software also considers the effect of metering and alarms on system operation. (Controls assumptions are largely determined by the system choice). There are just 2 questions to answer here (see Figure 53):

Controls Provision

1. Is this HVAC system separately sub-metered? - This refers to either energy metering of plant, and/or metering of plant hours run, and/or monitoring of internal temperatures in zones. If you click "Yes, it is", the following question becomes active:
    a. M&T with alarm for "out of range" values? – This refers to monitoring and targeting as a means of identifying changes in operation or onset of faults.

NB: The above two parameters on controls corrections are not available if the "Purpose of Analysis" parameter is set to 'Scottish Building Regulations' in the *General* form > *General Information* tab > *Project Details* sub-tab.

NB: If you have more than one HVAC system defined in your project, the *Metering Provision* sub-tab will be available for each one of them, i.e., each HVAC system can be separately sub-metered.

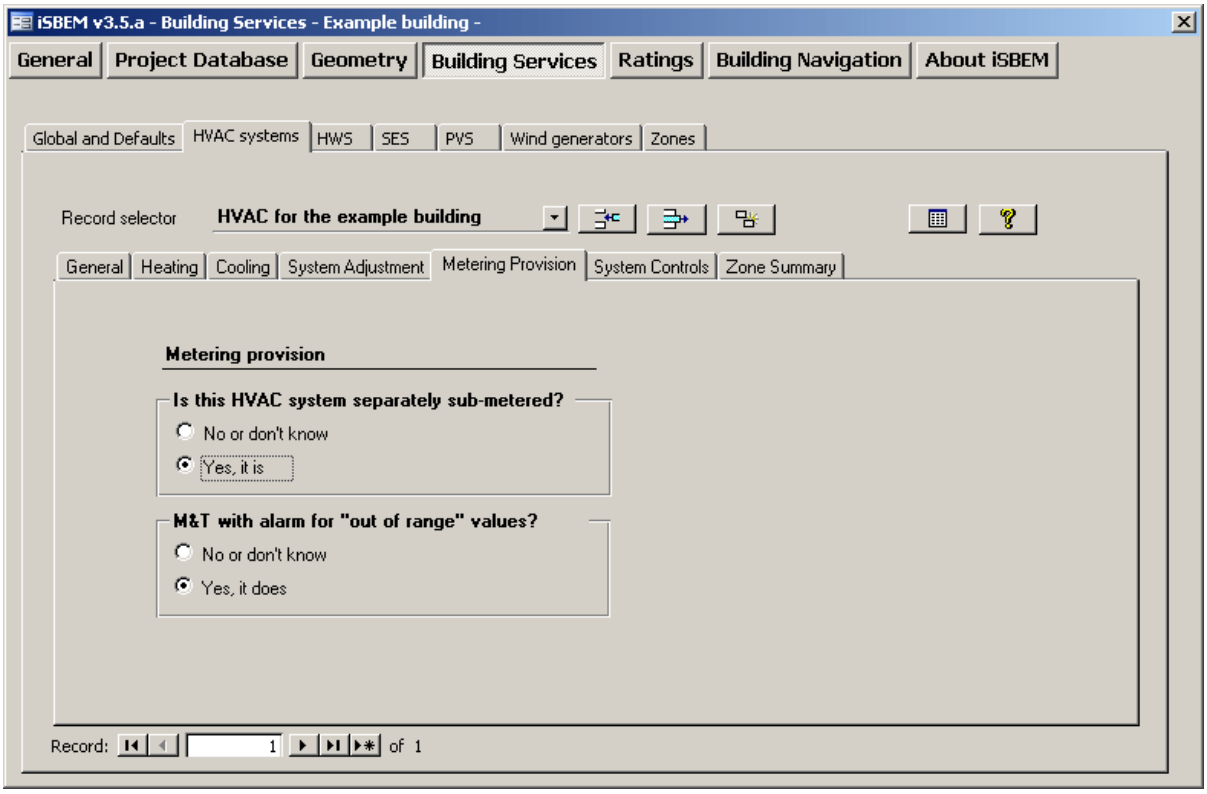


Figure 53: HVAC systems definition: Metering Provision sub-tab

System Controls sub-tab:

The software also needs to know if you have certain controls in your heating system, which would be considered during the production of the energy efficiency recommendations to accompany the EPC. This sub-tab is visible only if EPC generation is selected as the “Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab. There are 5 tick boxes in this sub-tab (see Figure 54):

Heating System Controls

1. Tick box to indicate whether the heating system has central time control.
2. Tick box to indicate whether the heating system has optimum start/stop control.
3. Tick box to indicate whether the heating system has local time control (i.e., room by room).
4. Tick box to indicate whether the heating system has local temperature control (i.e., room by room).
5. Tick box to indicate whether the heating system has weather compensation control.

NB: The HVAC system controls defined in the *System Controls* sub-tab are used by SBEM only for generating the EPC Recommendations for the Recommendations Report and do not affect the actual energy calculations or the input value for the system efficiency.

NB: If you have more than one HVAC system defined in your project, the *System Controls* sub-tab will be available for each one of them, i.e., each HVAC system can have control definitions different from the others.

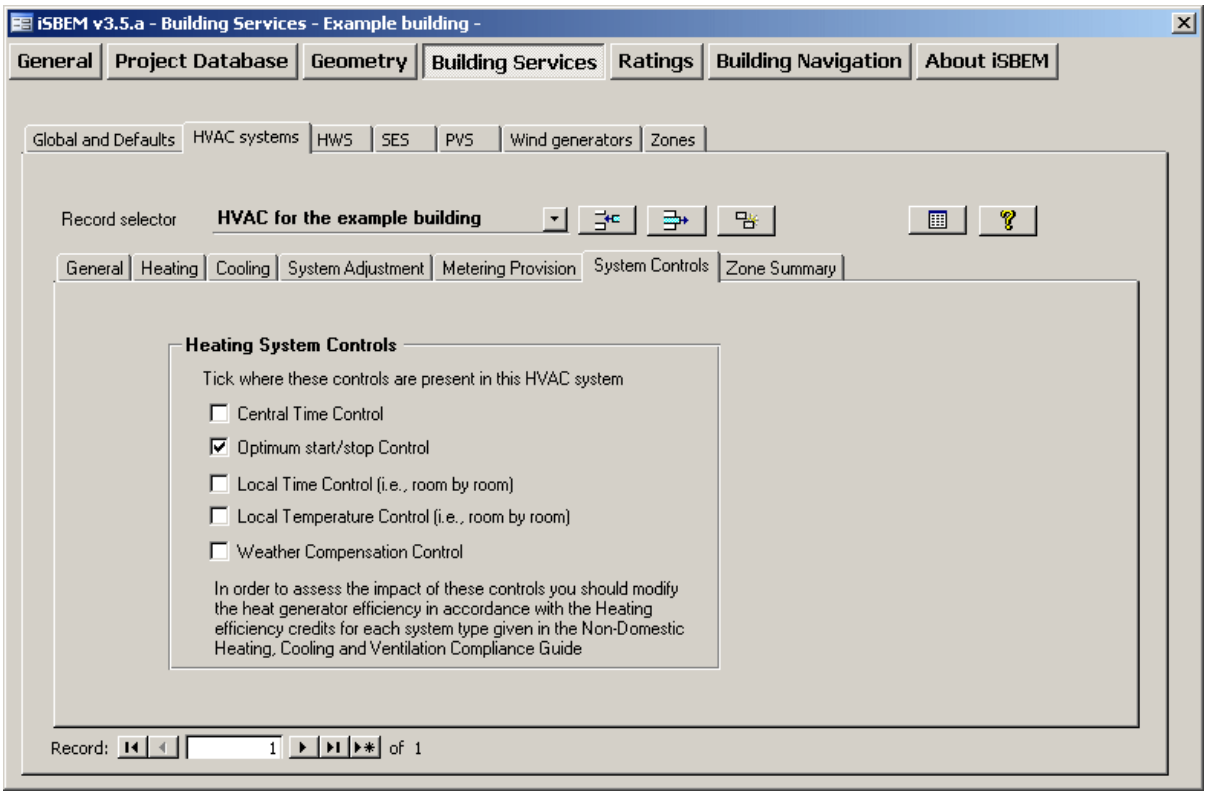


Figure 54: HVAC systems definition: System Controls sub-tab

Zone Summary sub-tab:

The names of the zones assigned to the HVAC system can be viewed in the *Zone Summary* sub-tab of the *HVAC Systems* tab, shown in Figure 55. The zones are listed in the left hand side window, and if any of the zones are highlighted, more details about that zone appear in the 'Zone's properties' window. For example, details such as the zone's area, and activity are displayed.

Task 14: Define the HVAC system for the Example building

The details on the HVAC system can be found in Section A.2: Systems. If you click into the *HVAC systems* tab, you will see that the HVAC system for the Example building has been named for you: "HVAC system for the Example building". You need to go through each of the sub-tabs in the *HVAC Systems* main tab in turn, entering the information provided in APPENDIX A:.

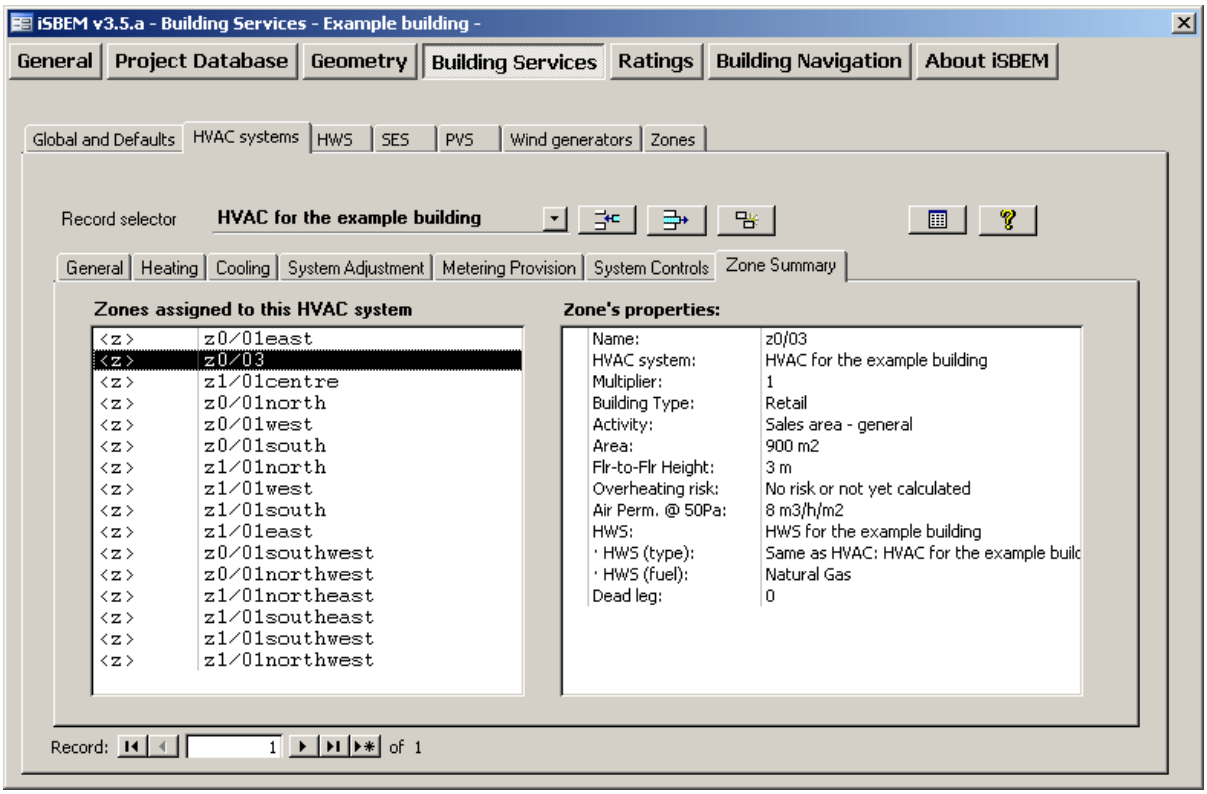


Figure 55: HVAC systems tab: Zone Summary sub-tab

7.6.3. Defining HWS – HWS tab

The *HWS* tab has three sub-tabs:

- **General** sub-tab: This is where the Hot Water System generator, fuel type, and efficiency are defined. (The HW system needs to be defined here before it can be assigned to any zones).
- NEW **Storage & Secondary Circulation** sub-tab: This is where the data on the hot water storage and secondary circulation are defined.
- **Assigned** sub-tab: This tab shows which zones each HWS is assigned to serve.

General sub-tab:

A HWS is defined by the following information:

1. Name – This needs to be a unique name.

NB: Note that the 'Multiplier' field no longer exists for HWS.

2. Generator type – Select from: Dedicated HWS boiler, Stand-alone water heater, Instantaneous HWS only, Instantaneous combi, Heat pump, or any of this project's HVAC systems previously defined in the *HVAC Systems* tab.

3. Is it later than 1998? - Tick if the system was installed later than 1998. The generator type selected above determines whether this tick box is enabled.

Further guidance

NB: For boiler systems installed from 1998 onwards, a default seasonal efficiency of 0.81 is suggested by the tool (based on Statutory Instrument 1994 No. 3083), and for boiler systems installed before this period, a conservative default seasonal efficiency of 0.65 is suggested. Please note that from around 1989, the boiler industry began producing boilers with efficiencies that would have complied with the above statutory instrument.

4. Fuel type – Depending on the generator type selected, a list of fuel types is available. For example, if "Instantaneous combi" is selected, you need to choose between: Natural gas, LPG, Biogas, and Oil. If one of the project's HVAC systems is chosen as the generator type, this field is not enabled as the fuel type would have been previously defined in the *HVAC Systems* tab.

5. Effective heat generating seasonal efficiency - If you know the effective heat generating seasonal efficiency for the HWS generator, it can be introduced manually into the interface. Otherwise, a default value will be used by SBEM. (This field is inactive if the HWS Generator type selected is 'Same as HVAC'). The default value is based on the above tick box on whether the generator was installed in or later than 1998.

Further guidance

NB: The Effective Heat Generating Seasonal Efficiency is calculated by adding the Heating Efficiency Credits, where applicable, to the Heat Generator Seasonal Efficiency. The Heat Generator Seasonal Efficiency is the ratio of the useful heat output to the energy input over the heating season. The Heating Efficiency Credits are available for additional controls and other measures that go beyond the required minimum controls package. Details of the minimum controls packages for the different systems, additional controls, and corresponding available credits are in the Non-Domestic Heating, Cooling, and Ventilation Compliance Guide published by CLG[xv]. Note that the necessary documentation to support the efficiency calculation may be required by Building Control.

Figure 56 shows a HWS generator being defined.

[xv] Available from (http://www.planningportal.gov.uk/uploads/br/BR_PDF_PTL_NONDOMHEAT.pdf)

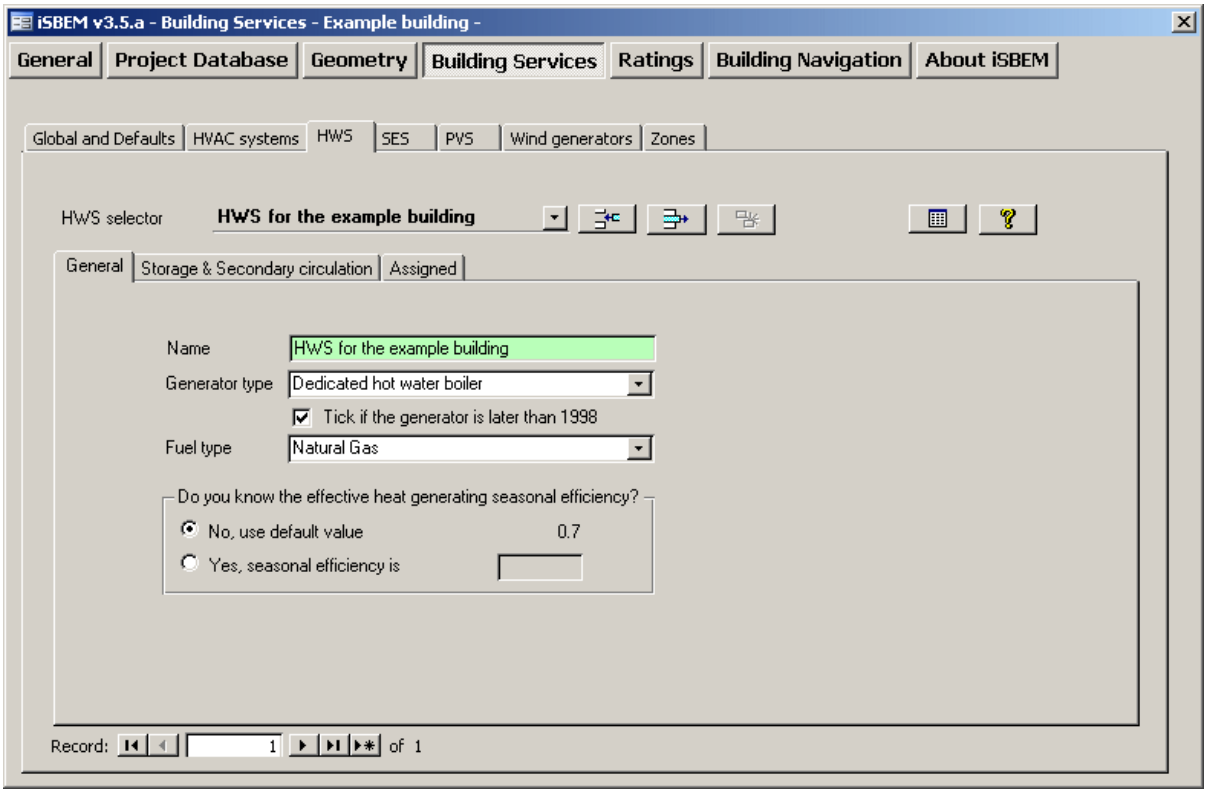


Figure 56: Defining a HWS in the General sub-tab

NEW

Storage & Secondary Circulation sub-tab:

In this sub-tab (Figure 57), you can enter the following information:

1. Is the system a storage system? – Tick if yes.
2. If the above tick box, regarding the a storage system, is ticked, the following fields become active:

   Either (depending on the selected radio button)

   a. Storage volume (volume of the HWS cylinder) in litres.

NEW

   b. Insulation type (on the HWS cylinder) – selected from the drop-down menu. If the option selected is not "Uninsulated", then the following parameter becomes active:

NEW

      i. Insulation thickness (on the HWS cylinder) in mm.

   or

   c. Storage losses in MJ/month.

   d. Does the system have secondary circulation? (tick box)

      i. If the secondary circulation tick box is ticked, default values will be assumed for heat losses per metre run (W/m), pump power (kW), and secondary pipework length (m). You can insert specific values if you know them.

      ii. Tick box if there is time control on the secondary circulation.

NB: If the above two boxes regarding a HWS storage volume and secondary circulation are activated but no values are entered by the user for the relevant parameters, the default values

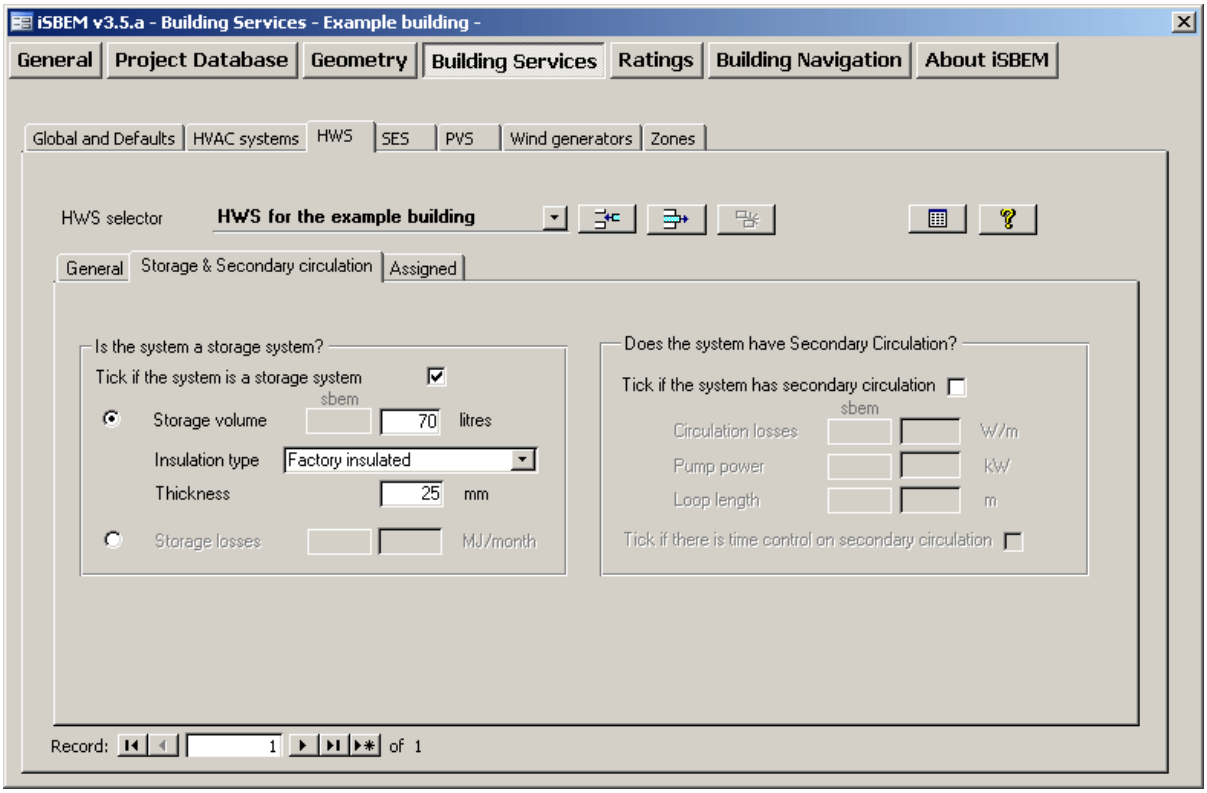
Further guidance

used in the SBEM calculation will be displayed within the interface after the calculation has been run. However, these calculated defaults would be quite pessimistic, and users are advised to enter their own values instead.

NB: If a solar energy system is connected to a HWS, then hot water storage is expected to exist.

NB: If the provision of hot water in any area/zone of the building consists of a combination of HWS generators that do not work simultaneously (such as an additional generator is for backup to ensure continuity of hot water supply in a hospital), then the storage volume entered into iSBEM for the HWS should refer to the maximum storage volume that can be used at any given time during the year. The same applies to storage losses. For example, if two identical HWS generators with independent storage are installed to provide a hospital with HWS but one generator and storage are only used in case there is a failure in the primary one, you would input into iSBEM the volume and storage losses associated with only one of the systems.

NB: Modelling trace heating in iSBEM: As an approximation, it can be considered that the energy used by trace heating is equivalent to that used by a secondary circulation. You can tick the box in the *Building Services* form > *HWS* tab > *General* sub-tab to indicate that there is a secondary circulation and then leave the rest of the secondary circulation related fields blank to be calculated by SBEM. You can also leave the deadleg at the default of 0 m.



NEW **Figure 57: HW Storage and Secondary Circulation sub-tab**

Assigned sub-tab:

The zones assigned to the HWS can be viewed in the *Assigned* sub-tab of the *HWS* tab, shown in Figure 58.

Task 15: Define the HWS

Details can be found in APPENDIX A:, Section A.2: Systems. Click into the *HWS* tab in the *Building Services* form. There is only one type of HWS in this building, and it needs to be named and defined here.

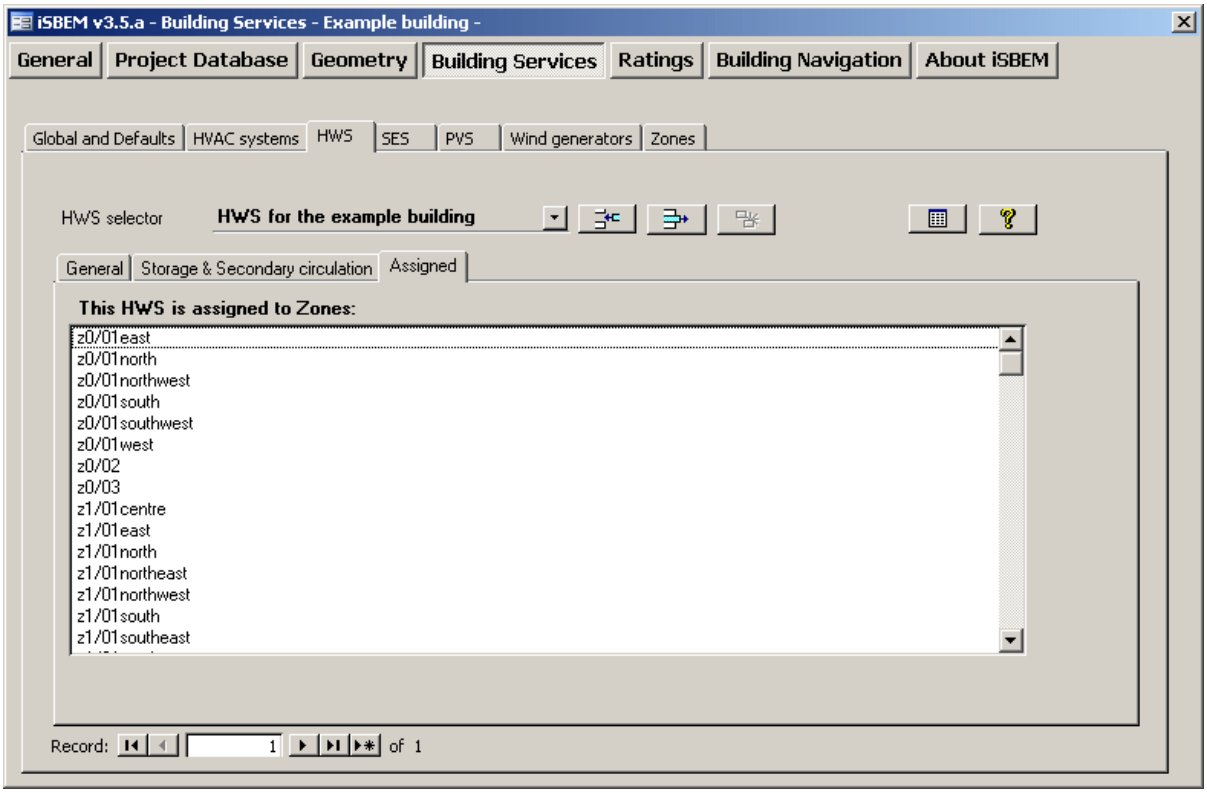


Figure 58: The Assigned sub-tab shows Zones to which the HWS has been assigned

7.6.4. Defining Solar Energy Systems (SES) – SES tab

There are three sub-tabs in the *SES* tab:

- **Collector Parameters** (renamed from **General**) sub-tab

NEW

- **Solar Storage & Collector Loop** sub-tab

NEW

- **Auxiliary Energy & Distribution Losses** sub-tab

NEW

NB: The overall performance of solar thermal systems depends on how the hot water system is used, e.g., daily draw-off patterns and the use of other water heating devices such as a back-up boiler or an immersion heater. The procedure followed in SBEM is not suitable for detailed design for a particular case. It is intended to give a representative value of the solar contribution to water heating over a range of users. The calculation methodology implemented in SBEM is based on the f-chart method and has been adopted from the standards EN 151316-4-3:2007 *Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 4-3: Heat generation systems, thermal solar systems*.

Collector Parameters (renamed from **General**) **sub-tab:**

The parameters required to define an SES in this sub-tab (see Figure 59) are:

1. Name – A unique name.

2. Multiplier – Indicate how many SES systems identical to this one are associated with the selected HWS.

3. In HWS - Select the HWS that this SES connects to, i.e., serves.

NB: It is important to assign the SES to the relevant hot water system. The drop-down list contains all the systems that you have already defined in the *HWS* tab. If the SES is not assigned to the HWS, it will not be linked to the building, and any solar contribution to the hot water demand will not be accounted for.

NB: If a solar energy system is connected to a HWS, then hot water storage is expected to exist.

Further guidance

4. Area – Aperture area of solar collector(s), in m^2. It refers to the solar collector maximum projected area through which un-concentrated solar radiation enters the collector. The collector aperture area should not be confused with the collector gross area which refers to the projected area of the complete collector.

Further guidance

5. Orientation - Select from the drop-down list: S, SE, SW, E, W, NE, NW, or N. The orientation and inclination of the solar collectors are needed for SBEM to calculate the solar radiation at the solar collector surface.

Further guidance

6. Inclination – Select from the drop-down list from between 0-90^o in 15^o intervals. The inclination of the solar panels is in degrees from the horizontal where 0 stands for a horizontal surface and 90 for a vertical surface. The orientation and inclination of the solar collectors are needed for SBEM to calculate the solar radiation at the solar collector surface.

NEW

7. Do you know the collector performance parameters according to EN 12975-2? – The preferred source of performance data for solar collectors is from a test on the collector concerned according to EN 12975-2: *Thermal solar systems and components – Solar collectors – Part 2: Test methods*. If test data are not available (e.g., for an existing installations), then the default values should be used by selecting:

   - No, use the default values from – you then need to select the collector type from the drop-down menu, and SBEM will use the corresponding default values as shown in Table 14.

Collector type selected	h_0	a_1	a_2	IAM
Unglazed	0.9	20	0	1
Flat plate	0.75	6	0	0.94
Evacuated tube	0.65	3	0	0.97

NEW

Table 14: Default solar collector performance parameters

On the other hand, if the performance parameters are known, then you should select:

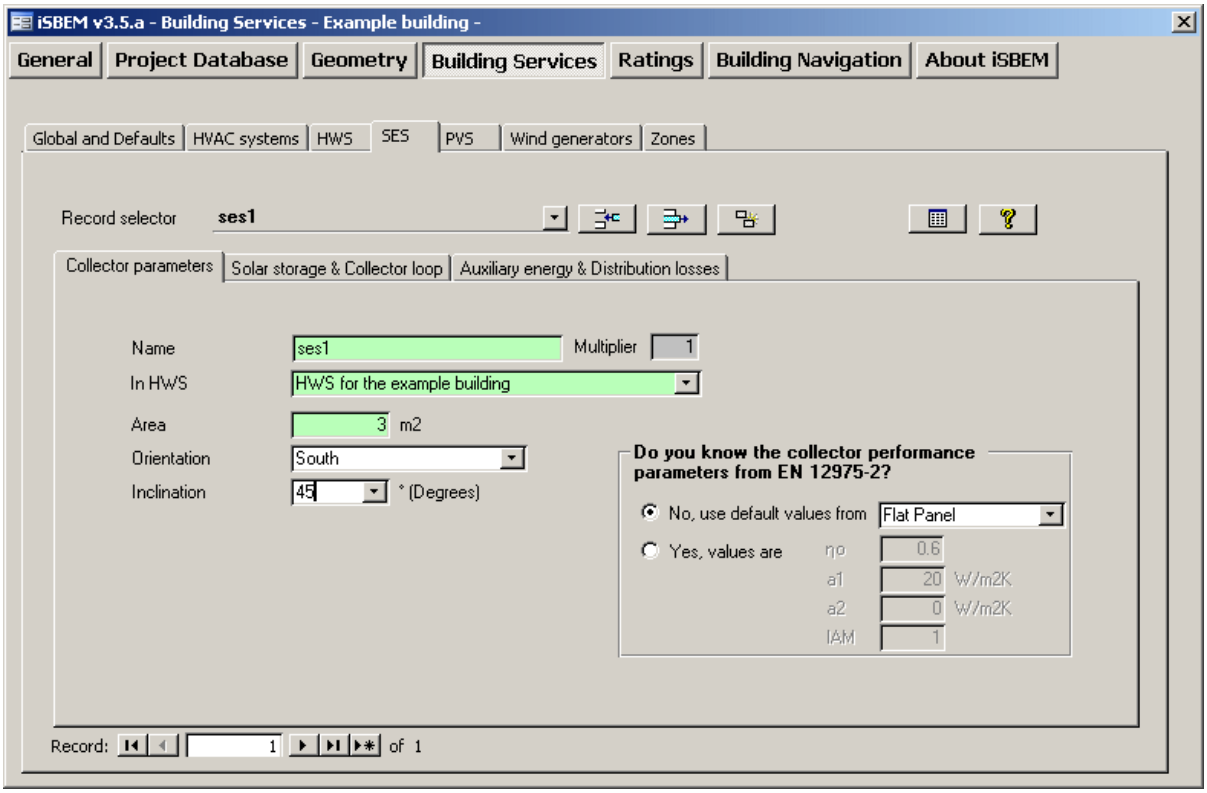
- Yes, the values are – you then need to enter the following parameters which will become active:

  a) η_0 – (sigma-zero) the zero-loss collector efficiency factor from the collector test standards EN 12975-2 and related to the aperture area.

  b) a_1 – the collector heat loss coefficient, in W/m^2K, from the collector test standards EN 12975-2 and related to the aperture area.

  c) a_2 – the temperature dependence of the heat loss coefficient, in W/m^2K, from the collector test standards EN 12975-2 and related to the aperture area.

  d) IAM – the incidence angle modifier (IAM) of the collector from the collector test standard EN 12975-2 when the test angle of incidence between it and the direct solar radiation for the test condition is 50°.



NEW **Figure 59: Defining a Solar Energy System in the Collector Parameters sub-tab**

NEW **Solar Storage & Collector Loop sub-tab:**

The parameters required to define an SES in this sub-tab (see Figure 61) are:

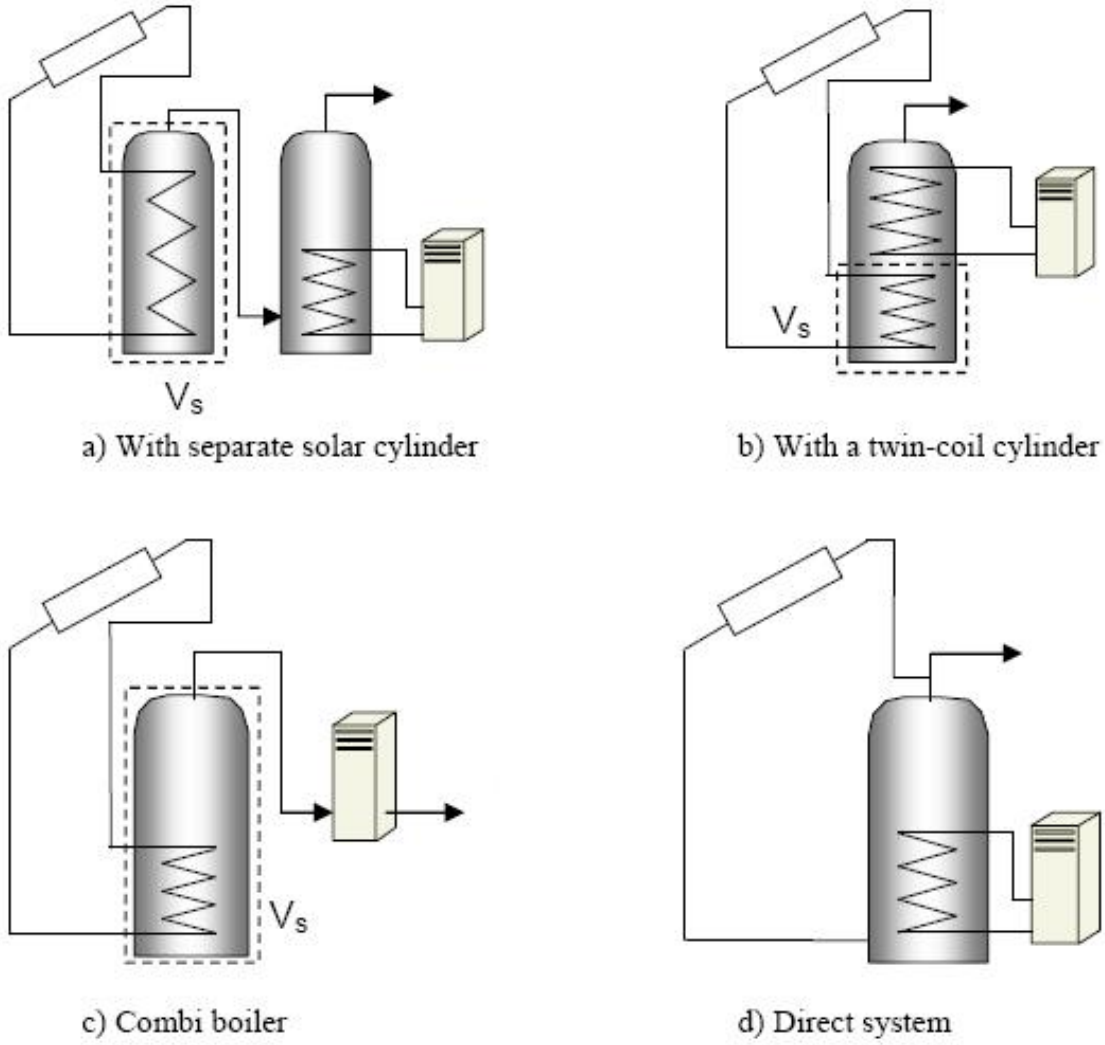
NEW 1. Solar storage volume - refers to the dedicated solar storage volume, in litres, and it should be calculated according to the arrangements for solar pre-heating as indicated in the schematic in Figure 60 and the guidance below:

- in the case of one or more separate pre-heat tanks, such as arrangements a) or c) in Figure 60, the solar storage volume is the volume of the pre-heat tank(s).
- in the case of a combined cylinder, such as arrangement b) in Figure 60, the solar storage volume is the volume between the bottom of the lowest back-up element (electric element or heat exchanger) to the lowest element of the solar primary.
- in the case of a thermal store (hot water only) where (only) the solar coil is within the thermal store, the solar storage volume is the volume of the dedicated thermal storage.
- in the case of a direct system, such as arrangement d) in Figure 60, the solar volume should be calculated as 0.3 times the volume of the cylinder.

NEW **NB:** The schematic examples reflected in the Figure 60 are unlikely to represent all types of commercial solar thermal installations. Where necessary, and for more complex systems, an accredited dynamic simulation tool can be used.

NEW **NB:** The dedicated solar volume of a solar thermal installation varies depending on the control and timing strategy of the of the back-up system. To optimise the performance of the solar thermal system, the back-up system should be prevented from operating during and prior to the period of the day where the solar radiation is strong enough to contribute to the hot water requirements. Where it can be demonstrated that the dedicated solar volume should be

calculated following a different approach to the guidelines given here, alternative calculations can be used as long as they are in agreement with the UK Micro Certification Scheme standards in effect at that time. The detail and justifications of the calculations undertaken will need to be submitted to the Building Control officer.



V_s (indicated by the dashed line) is the dedicated solar storage volume.

NEW **Figure 60: Schematic examples of arrangements for solar pre-heating (*These schematics are not intended to show safety measures or devices needed to make the systems safe.*) – Adapted from SAP2005**

NEW 2. Solar pre-heating type – you need to select an option from the drop-down menu as follows:

- Separate solar cylinder- when there is one or more dedicated solar storage vessels that are heated with the solar collectors only and that do not contain any other heating sources, i.e., the solar energy system has a storage cylinder that is independent of that for the hot water system storage.
- Combined cylinder - the solar storage is combined in a hot water cylinder with one or more back-up sources, i.e., the solar energy system shares the same storage vessel with the hot water system.

NEW 3. Insulation type (on the solar storage cylinder) – selected from the drop-down menu. If the option selected is not "Uninsulated", then the following parameter becomes active:

NEW a. Insulation thickness (on the solar storage cylinder) in mm.

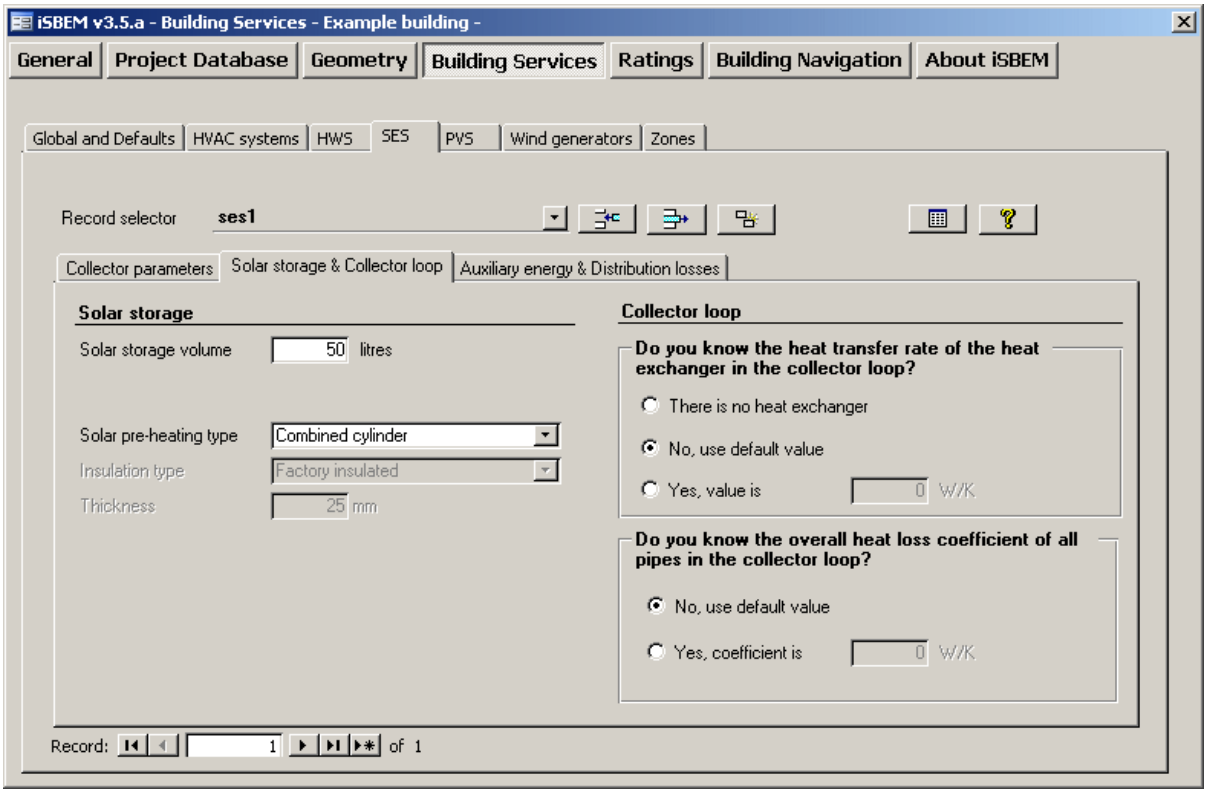
NEW 4. Do you know the heat transfer rate of the heat exchanger(s) in the collector loop? – you need to select one of the following options:

- There is no heat exchanger - For solar thermal direct systems in which the solar primary transmission fluid and the consumed water are the same, i.e., arrangement d) in Figure 60, you should select this option. Otherwise, for indirect systems where the primary circuit fluid is different to that of the secondary side of the system, there will be one or more heat exchangers in the storage vessel, and you should selected one of the other two options below.
- No, use the default value.
- Yes, the value is – you need to input the heat transfer rate, in W/K, in the box that will become active. For small systems, the heat transfer rate of the heat exchanger in the solar loop can be obtained from test results according to the standards EN 12975-3 - *Performance characterisation of stores for solar heating systems*. For large systems, the value can be taken from the heat exchanger performance data sheet provided by the manufacturer. For systems with more than one heat exchanger, using an intermediary or tertiary arrangement such as with a thermal store, an equivalent heat transfer rate can be input by the user (alternatively, dynamic simulation compliance tools can be used).

NEW **NB:** The solar collector loop refers to all elements located between the solar collector and the point where the back-up heating source supplies the hot water system with energy.

NEW 5. Do you know the overall heat loss coefficient of all pipes in the collector loop? – you need to select one of the following options:

- No, use the default value.
- Yes, the value is – you need to input the heat loss coefficient, in W/K, in the box that will become active. This is the overall heat loss coefficient of all pipes in the solar loop, including pipes between collectors and array pipes between the collector array and the solar storage tank(s). If the pipe and insulation for the solar loop are known, the overall heat loss coefficient of all the pipes in the solar loop can be calculated accordingly (see for instance *John A. Duffie and William A. Beckman: Solar Engineering of Thermal Process. Wiley-Interscience ed., 1991*).



NEW **Figure 61: Defining a Solar Energy System in the Solar Storage & Collector Loop sub-tab**

NEW **Auxiliary Energy & Distribution Losses sub-tab:**

The parameters required to define an SES in this sub-tab (see Figure 62) are:

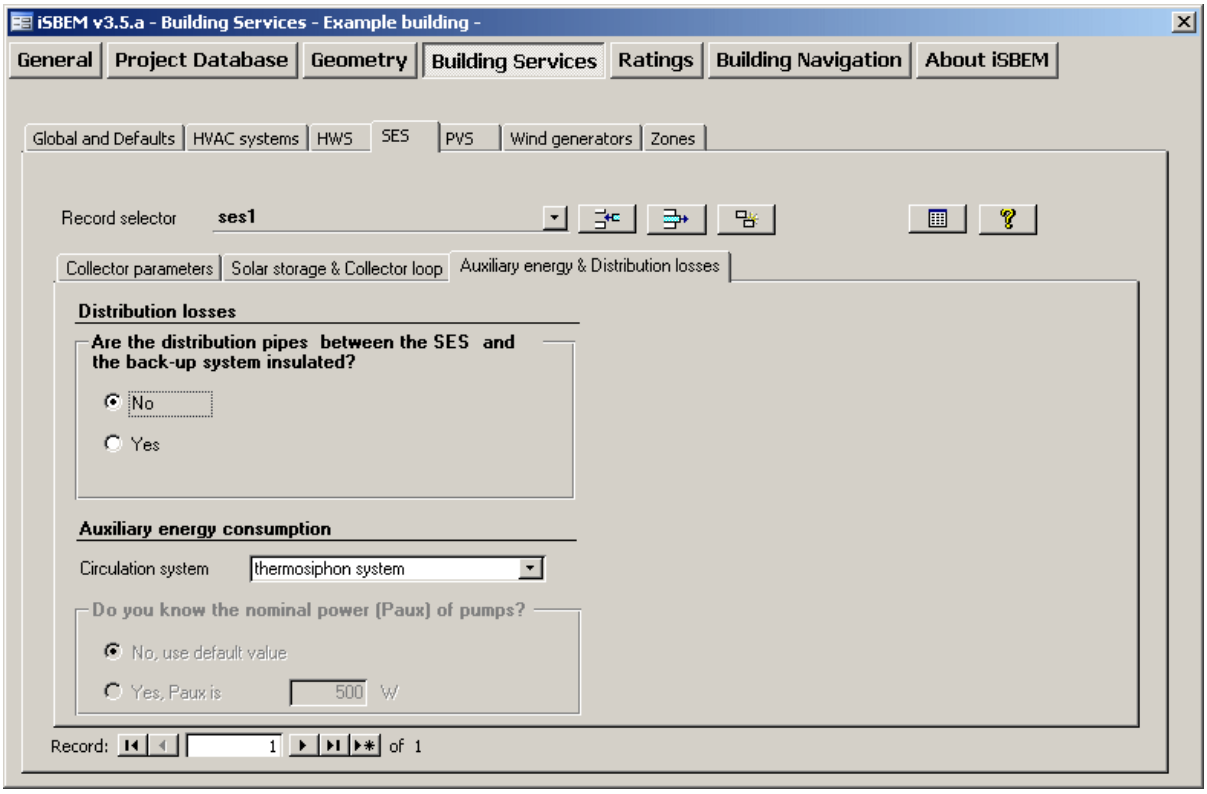
NEW 1. Are the distribution pipes between the solar energy system and the back-up system insulated? – you need to select either yes or no. If there are pipes between the solar thermal system and the back-up heating system, this parameter is used to estimate the thermal losses of the distribution between the solar thermal system and back-up heater. This parameter becomes active only if the "Solar pre-heating type" parameter in the *Solar Storage & Collector Loop* sub-tab has been set to "Separate solar cylinder".

NEW 2. Circulation system – you need to select one option from the drop-down menu. If the option selected is 'forced circulation system with no PV', then the following parameter becomes active:

   a. Do you know the nominal power of the pumps? – you need to select one of the following options:

      - No, use the default value.
      - Yes, the value is – you need to input the nominal power, in W, in the box that will become active.

NEW **NB:** The auxiliary energy consumption required by the circulation pumps in the solar system is calculated according to the type of circulation system. For thermosiphon systems and forced circulation systems assisted with photovoltaics, the auxiliary energy consumption is zero. For forced circulation systems that require grid-electricity for the circulation pump in the solar loop, the user needs to enter the nominal input power of the pumps, which is the power stated on the pumps label. For a multi-stage pump, the power corresponding to the typical operation mode should be chosen.



NEW **Figure 62: Defining a Solar Energy System in the Auxiliary Energy & Distribution Losses sub-tab**

NB: There are no SESs in the Example building so there is no task here.

7.6.5. Defining a Photovoltaic system (PVS) – PVS tab

SBEM allows the user to define a PVS in order to provide a percentage of the electrical demand of the building (see Figure 63) by displacing grid-supplied electricity. There is only one sub-tab in the *PVS* tab:

- **General** sub-tab

General sub-tab:

The definition of a PVS requires:

1. Name – A unique name
2. Multiplier – Indicate how many PVS identical to this one exist in the building.
3. Type – Choose from the drop-down list whether it is: Monocrystalline silicon, Polycrystalline silicon, Amorphous silicon, or Other thin films.
4. Area – Area of the photovoltaic panel (m^2).
5. Orientation - Select from the drop-down list: S, SE, SW, E, W, NE, NW, or N.
6. Inclination – Select from the drop-down list from between 0-90^o in 15^o intervals. The inclination of the photovoltaic panels is in degrees from the horizontal where 0 stands for a horizontal surface and 90 for a vertical surface.

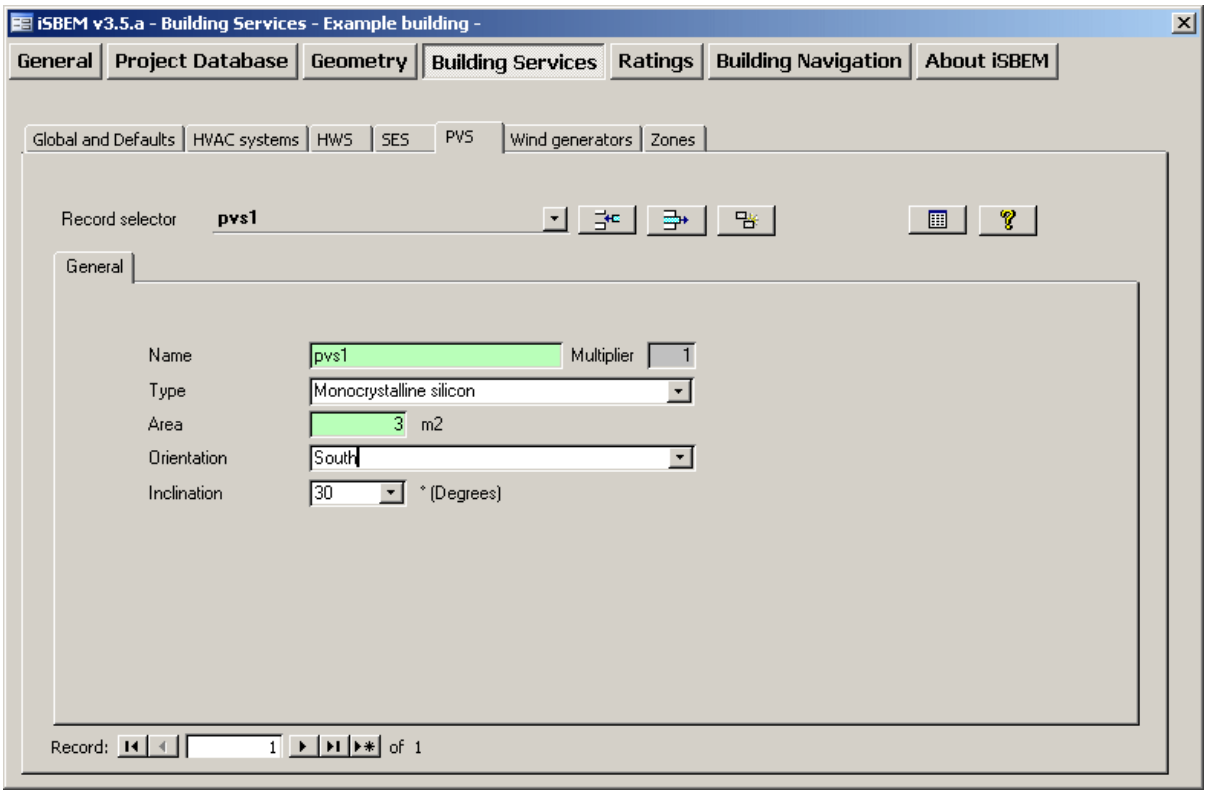


Figure 63: Defining a PVS

NB: There are no PVSs in the Example building so there is no task here.

7.6.6. Defining a wind generator – Wind Generators tab

As with PVSs, SBEM displaces the grid-supplied electricity with that produced by any wind generators defined in this tab. There is only one sub-tab in the *Wind Generators* tab:

- **General** sub-tab

General sub-tab:

The parameters needed to define a wind generator are (see Figure 64):

1. Name – A unique name.
2. Multiplier – Indicate how many wind generators identical to this one exist in the building.
3. Terrain type – This indicates the type of terrain where the wind turbine is located. Select from: Smooth flat country (no obstacles), Farm land with boundary hedges, Suburban or industrial area, and Urban with average building height > 15m.
4. Radio button to indicate whether the wind turbine has a horizontal axis or not. If it is a horizontal axis turbine, you are asked to enter:
    - Diameter – Wind turbine rotor diameter, in m. iSBEM will use the entered diameter to calculate the area swept by the rotor blades.

    If the wind turbine does not have a horizontal axis, e.g., it is a vertical axis wind turbine, then you are instead asked to enter:
    - Area – area swept by the rotor blades, in m^2.

NB: The swept area of a wind turbine is used to calculate the area of air intercepted by the turbine rotor. For axial horizontal wind turbines, you can enter the rotor diameter, *D*, in m, and the swept area, *A*, is automatically calculated by iSBEM as the area of the circle delineated by the turbine's blades, and it is calculated as: $A = p \cdot \frac{D^2}{4}$ For any other type of wind turbines, including vertical axis wind turbines, you need to enter the area swept by the rotor, in m^2. Contact the turbine manufacturer if in any doubt.

5. Hub height – The wind turbine hub height, in m.

   NB: The height of the turbine is used to adjust the wind speed values during the calculation. For axial horizontal wind turbines, this corresponds to the turbine hub height measured from the ground. For other rotor types including vertical axis wind turbines use the geometric centre of the turbine rotor.

6. Power – The wind turbine rated power (electrical power delivered at rated wind speed), in kW.

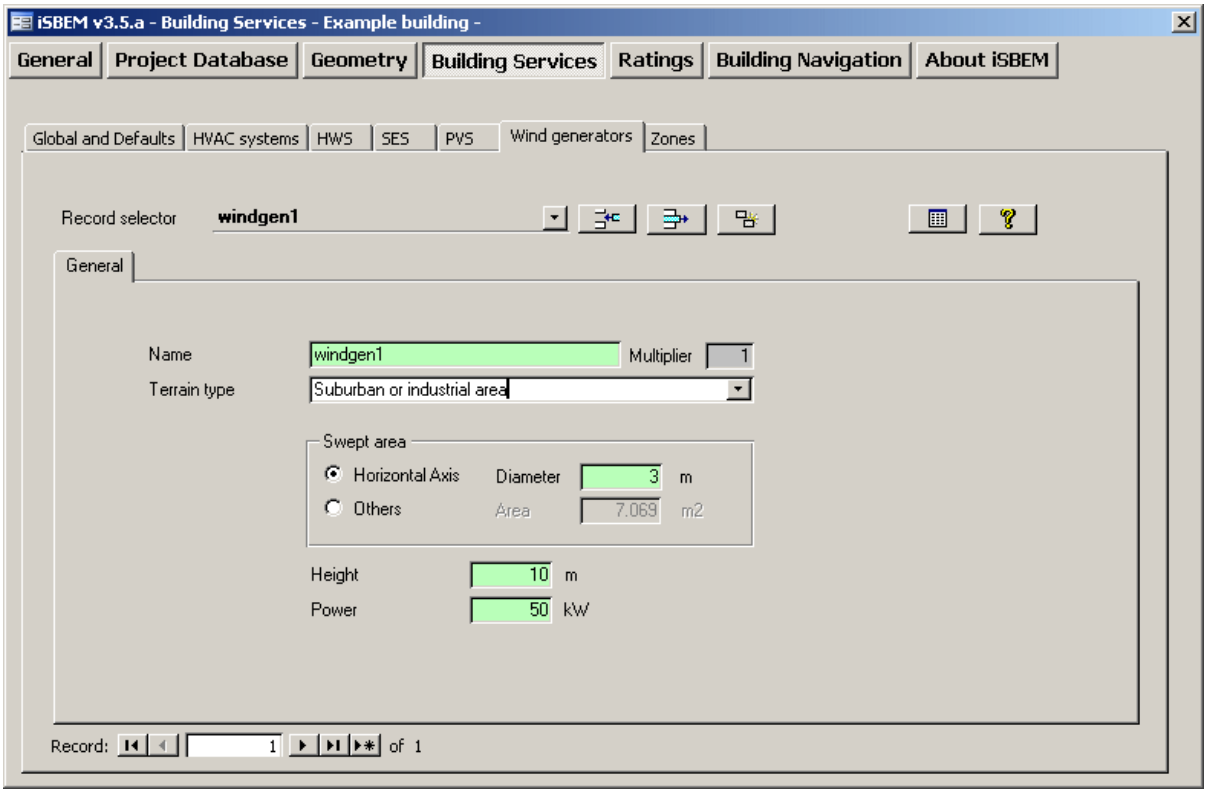


Figure 64: Defining a wind generator

NB: There are no wind generators in the Example building so there is no task here.

7.6.7. Defining the CHP generator – CHP Generator tab

This tab only appears if one of the HVAC systems, defined in the *HVAC Systems* tab, is specified to use a Combined Heating and Power (CHP) generator for provision of hot water, space heating, and electrical power, or a Combined Cooling, Heating, and Power (CCHP) generator for provision of hot water, space cooling, space heating, and electrical energy (i.e., the relevant box is ticked).

There is only one sub-tab in the *CHP Generator* tab:

- **General** sub-tab

General sub-tab:

The parameters required to describe the CHP generator are (see Figure 65):

1. Fuel type – Select from: Natural gas, LPG, Biogas, Oil, Coal, Anthracite, Smokeless fuel (inc coke), Dual fuel appliances (mineral + wood), Biomass, and Waste heat.
2. Heat efficiency – the seasonal thermal efficiency of the CCHP generator, defined as the total annual useful heat supplied by the generator divided by the total annual fuel energy input to the generator (using the gross calorific value).
3. Electrical efficiency - it is calculated as the total annual electric power output by the CHP divided by the total annual fuel energy input (using the gross calorific value).

NB: Values for the heat and electrical efficiencies are entered as ratios into iSBEM, not as percentages. For instance, a 30% electrical efficiency should be entered as 0.3 into iSBEM. For information regarding Part L minimum requirements for CHP and CCHP installations in England and Wales, please refer to the latest approved version of the Non-Domestic Heating, Cooling and ventilation Compliance Guide.

NB: The heat to power ratio is automatically calculated by iSBEM as the heat efficiency divided by the electrical efficiency of the CHP.

4. CHPQA Quality Index - an indicator of the energy efficiency and environmental performance of a CHP scheme relative to the generation of the same amounts of heat and power by separate alternative means.

NB: The Quality Index (QI) provides a means of assessing the quality of CHP Schemes. In SBEM, it is currently used for reporting purposes only, i.e., it is not used in the calculations. For information regarding Part L minimum requirements for CHP and CCHP installations in England and Wales, please refer to the latest approved version of the Non-Domestic Heating, Cooling and ventilation Compliance Guide.

5. Proportion of space heating supplied to the building - (%). This average monthly value needs to be calculated through a detailed analysis of the building's space heating demand values and patterns. Note that he CHP unit is normally sized below the peak heating demand of the building and will also be out of service at particular times for maintenance purposes.

Further guidance

6. Proportion of hot water supplied to the building - (%).This average monthly value needs to be calculated through a detailed analysis of the building's water heating demand values and patterns. Note that he CHP unit is normally sized below the peak heating demand of the building and will also be out of service at particular times for maintenance purposes.

Further guidance

NB: The CHP can provide a proportion of the building's hot water only if the HWS generator is set to be the same as the HVAC system to which the CHP is connected.

7. Tick box to indicate whether this is a trigeneration system (i.e., it provides cooling, heating, and power) or not (i.e., it provides heating and power). If the box is ticked, the following fields become active:
    a. Proportion of space cooling supplied to the building - (%).
    b. Chiller efficiency - the seasonal chiller efficiency of the generator, defined as the cooling demand divided by the cooling energy for the generator.

NB: SBEM is not a design tool. The values of the parameters entered in the CHP Generator sub-tab need to have come from a previous detailed analysis.

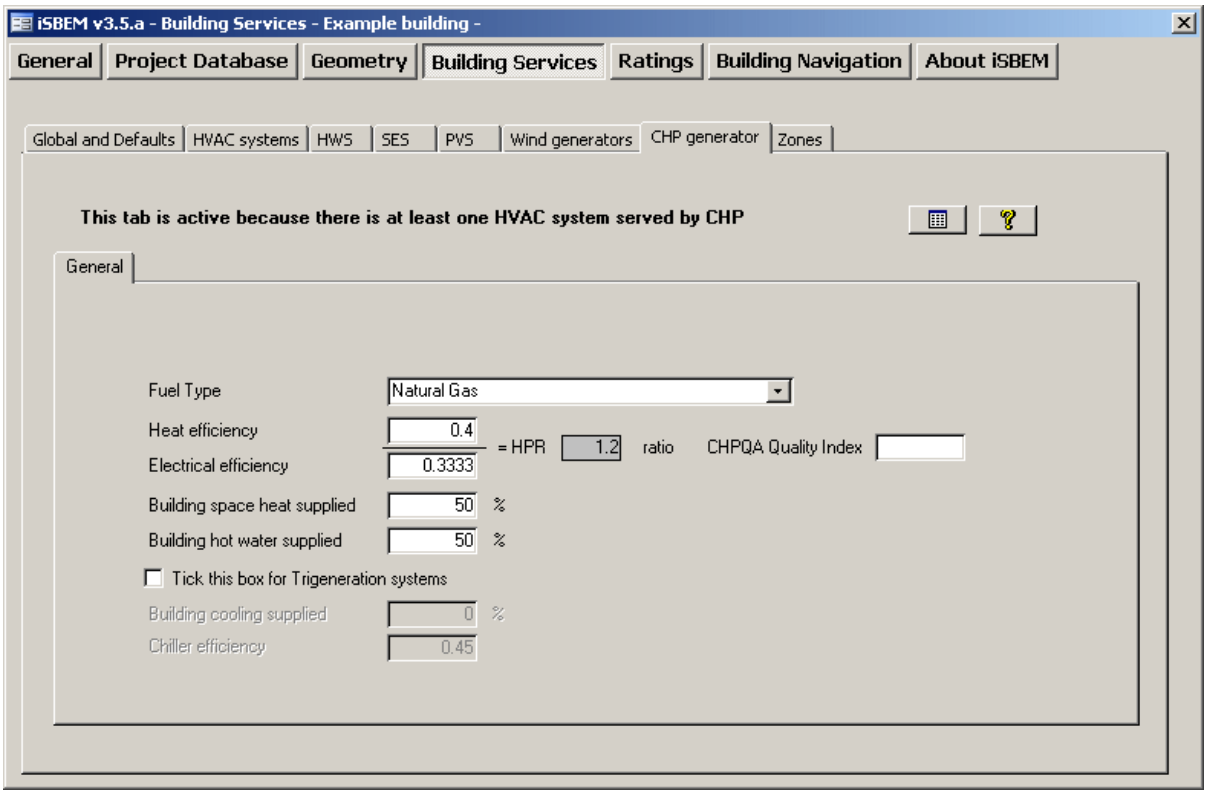


Figure 65: Defining a CHP generator: CHP Generator tab

NB: There is no CHP generator in the Example building so there is no task here.

7.6.8. Defining the zone specific building services- Zones tab

The zone definition is not completed within the *Zones* tab in the *Geometry* form. Some zone parameters (related to building services) are defined within the *Building Services* form, under the *Zones* tab. There are six sub-tabs in the *Zones* tab:

- **HVAC, HWS, and Lighting Systems** sub-tab: This is where you assign the HVAC system and HWS which serve each zone. In this sub-tab also, the results on the risk of overheating in the zone are displayed after the calculation has run successfully.
- **Ventilation** sub-tab: This is where you define the ventilation type and characteristics for each zone.
- **Exhaust** sub-tab: This is where you define an exhaust system in a zone.
- **Lighting (General)** sub-tab: This is where you enter details about the general lighting characteristics for each zone.
- **Lighting (Controls)** sub-tab: This is where you enter details about the lighting controls for each zone.
- **Display Lighting** sub-tab: This is where you enter details about display lighting characteristics and controls for each zone.

HVAC, HWS, and Lighting Systems sub-tab:

The sub-tab is used to specify the HVAC system and HWS for each zone. The following information is required:

HVAC System Parameters

1. HVAC Systems – Here you need to select from the drop-down list (of systems you have already defined in the *HVAC Systems* tab or the default systems) the HVAC system which serves the zone. If no HVAC system serves the space (i.e., an unconditioned zone), select 'Zones without HVAC system' (spaces which have no heating or cooling, e.g., plant rooms, storage spaces, exposed circulation spaces).

Further guidance

NB: If a zone is defined as having no heating or cooling, i.e., assigned to 'Zones without HVAC system', but the activity type selected for the zone is one which typically requires conditioning (according to the Activity Database), a red exclamation mark "**!**" will appear next to this parameter as a warning to the user, in case this was done in error. Ultimately, however, the calculation will be carried out using the data input by the user.

If you do not know the type of the HVAC system in your existing building or its detailed parameters, you should select one of the following default options from the drop-down menu:

- 'Heating only - Electric resistance' - Heat generated by passing current through resistance wire. Assumed to be electric central heating system with warm air distribution. Fan storage heaters and electric fan converters should be input by defining an HVAC system in the *Building Services* form > *HVAC Systems* tab > *General* sub-tab and selecting the system type "Other local room heater - fanned". If you do not know the heating method (i.e., whether a heated-only building uses electricity or a fuel-based heating system), you should select electric resistance heating as your default.
- 'Heating only - Other systems' - Assumed to be wet radiator system, heat generated by fuel combustion. Pumps assumed to be powered by grid-supplied electricity. If you know the fuel type used by the heating system, you can define it in the *Building Services* form > *Global and Defaults* tab > *HVAC System Defaults* sub-tab (see Section 7.6.1: Global and Defaults tab).
- 'Heating and mechanical cooling' - Assumed to be constant volume air system with terminal reheat and fixed fresh air. Refrigeration (chillers), fans, and pumps assumed to be powered by grid-supplied electricity. If you know the fuel type used by the heating system, you can define it in the *Building Services* form > *Global and Defaults* tab > *HVAC System Defaults* sub-tab (see Section 7.6.1: Global and Defaults tab).

NB: The default HVAC systems are representative of existing rather than new buildings and should only be used if you do not know the type of the HVAC system in your building or its detailed parameters as the default efficiencies assumed by iSBEM for them are quite pessimistic and cannot be edited by the user.

NB: Indirectly heated spaces - For spaces such as corridors or access areas, which are not serviced by an HVAC system (i.e., have no direct supply of heating or cooling) but are likely to be indirectly conditioned by the surrounding areas due to the high level of interaction with those spaces (allowing the heated air to move freely from the directly conditioned spaces to the indirectly conditioned ones), they should be considered heated or conditioned (indirectly) by the same HVAC system that supplies the most important surrounding area. In this case, you should assign the HVAC system of the main adjacent space to that indirectly conditioned zone also (although the space is not directly conditioned, the energy to overcome any losses from or gains to it is still required via the conditioned zone, and therefore has to be included in the calculation). An example of this would be an open corridor (to heated offices) or a stairwell next and open to offices, i.e., which might have a few envelope elements but is mostly open to the surrounding conditioned areas and which is not directly conditioned but is conditioned through the movement of air (and heat) from the adjacent offices into the corridor. Furthermore, envelope elements between a (directly) conditioned space and an indirectly conditioned space should be labelled as adjacent to a "conditioned adjoining space" and not to an "unheated adjoining space". On the other hand, if a zone is unheated and totally enclosed thus heated air cannot freely move from a

heated zone into it, such as a plant room, a store room, or a toilet, you are advised to define it in iSBEM as "Zones without HVAC".

NB: If there is **more than one type of HVAC system in a space** with each system clearly meant to service a particular part of the space, e.g., one servicing the facade perimeter area and another servicing the core area, then the space should be divided into 2 separate zones in iSBEM (each served by its corresponding HVAC system) even if there is no physical separation between the 2 zones. However, if heating is provided in a zone by two, or more, different types of heat sources, for e.g., a heat pump in a split system and a gas boiler in a wet system, you need to calculate (and enter into iSBEM) a seasonal heat generating efficiency which is equivalent to both these heat sources based on their respective efficiencies, fuel types, and loads, as described in the guidance on the bivalent calculation in Section 7.6.2: Defining HVAC Systems – HVAC Systems tab. On the other hand, if a zone is served by, for e.g., a gas-fired wet system for heating and an electric split system for cooling, then the systems can be approximated in SBEM by defining your HVAC system type as "split or multisplit", the heat source as "LTHW boiler", and fuel type as "natural gas", and then define the appropriate seasonal efficiency for the heating and energy efficiency ratio for the cooling. SBEM will use natural gas for the heating and grid-supplied electricity for the cooling. If applicable, you then need to define the mechanical ventilation at zone level (for all the zones served by this system) with a suitable ventilation SFP, and heat recovery.

2. Are there destratification fans in the zone? (Tick box) - Destratification fans provide additional air recirculation in the zone to ensure even temperature distribution (while these would help reduce heating loads, they would increase auxiliary energy loads).

NB: Destratification may be achieved by several means, for each of which minimum flow rates should be ensured. (Where destratification and heating is provided by the same system, higher flow rates may be needed to avoid excessive air supply temperatures):

- Cased fans installed at high level. The volume of air handled by the fans should be at least equivalent to two room volumes per hour. Total air movement will be higher than this because additional airflow will be induced.
- Open blade “sweep fans”. In this case, air speeds will be lower and the volume of air handled should be at least the equivalent of 6 room volumes per hour.
- High velocity induction nozzles with a temperature rise through the heater of at least 45ºC. The volume of primary air from the nozzles should be at least equivalent to 0.15 room volumes per hour. Total air movement will be significantly higher because of the additional airflow induced by the nozzles.

NB: If your HVAC system is a high velocity forced-convection air heating (induction nozzle system), which does the job of mixing the air in the zone in a similar manner to destratification fans, then you can model this in iSBEM by first selecting the appropriate HVAC system type (flued or unflued) and then ticking the above box relating to destratification fans in the zones served by that system. The system should follow the flow rate guidelines given for destratification systems shown above. You will then need to justify this to Building Control using the necessary documentation for your system's functions.

Hot Water System

3. HWS - A HWS needs to be selected for:
    a. All occupied zones - Depending on the activity and building type selected for the zone, a standard hot water demand is assumed. For example, there is a demand assumed to arise from the occupants of an office for activities such as washing hands and washing up cups. This demand is associated with the office rather than the toilet or tea room. Thus, the demand from each space needs to be assigned to a HWS even if the system itself is not present in the space. If there is more than one HWS serving the building, the HWS that needs to be specified for a zone should be the generator which accounts for

the majority of its demand. A HWS needs to be assigned to every zone defined in iSBEM.

b. Any space with a deadleg within it – As described above, hot water demand is associated with occupied spaces rather than the spaces. However, if there is a deadleg within the zone, it needs to be associated with the appropriate system, through the zone it serves.

4. Deadleg length in this zone - Length of the draw-off pipe to the outlet in the space (only used for zones where the water is drawn off, such as toilets and tea rooms). This parameter is used to determine the additional volume of water to be heated because the cold water in the deadleg has to be drawn off before hot water is obtained. This assumes that the hot water system circulation maintains hot water up to the boundary of the zone, or that the pipe runs from circulation or storage vessel within the zone.

NB: Modelling trace heating in iSBEM: As an approximation, it can be considered that the energy used by trace heating is equivalent to that used by a secondary circulation. You can tick the box in the *Building Services* form > *HWS* tab > *General* sub-tab to indicate that there is a secondary circulation and then leave the rest of the secondary circulation related fields blank to be calculated by SBEM. You can also leave the deadleg at the default of 0 m.

Lighting System

5. Lighting System – This field will become active in future versions of the tool and will enable the user to select a lighting system for the zone from a previously defined list of systems, similar to that for HVAC systems and HWSs.

Risk of overheating in this zone.

SBEM runs an overheating calculation in order to provide recommendations in the report which accompanies the EPC. After the calculation runs successfully, the risk of overheating in each zone is reported in this sub-tab (Figure 66).

Figure 66 shows a zone's HVAC, HWS, and lighting characteristics being defined.

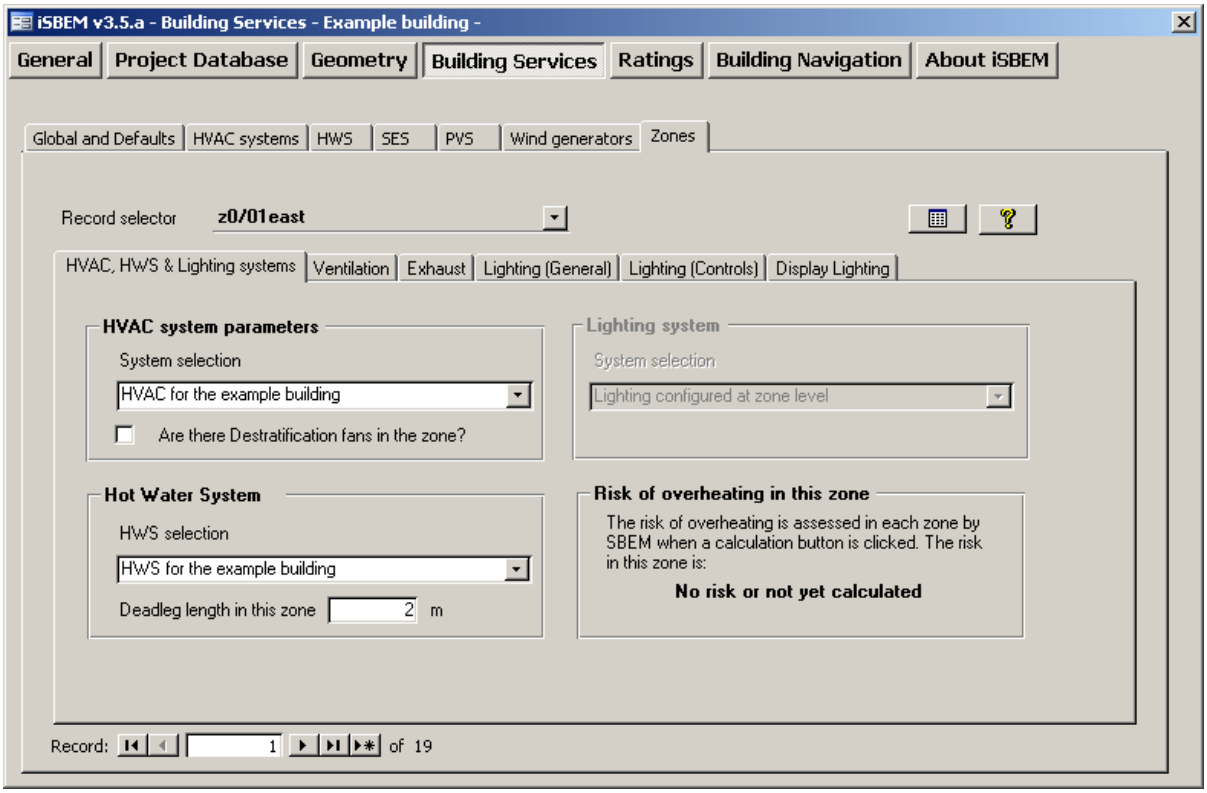


Figure 66: Selecting a zone's HVAC, HWS, and lighting systems

Ventilation sub-tab:

This sub-tab is used to specify the type of ventilation system specific for each zone. The following information is required:

Zonal Ventilation Type

1. Zonal ventilation type – A mechanical ventilation system separate from the heating or cooling system (i.e., zonal ventilation) can be added here. If the selected HVAC system does not already include ventilation, the zonal ventilation radio buttons become active. This would be possible, for example, with radiators or under-floor heating. You need to select either: Natural or Mechanical supply & extract, according to whether there is a mechanical ventilation system present in the zone to provide fresh air.

Further guidance

Convention: Convention for EPCs - Passive stack ventilation

The convention is that passive stack should be treated as natural ventilation.

NB: In order to ensure adequate ventilation for maintaining the concentration of CO_2 below 0.5% in spaces served by unflued heating appliances[xvi], the zonal ventilation option for these spaces should be set to 'mechanical'.

NB: The supply and extract flow rate for all ventilation systems is set to take the minimum fresh air requirements value from the NCM Activity Database.

NB: Zonal ventilation is no longer available for fan coil units. Ventilation for this HVAC type is defined at HVAC level. See note in Section 7.6.2: Defining HVAC Systems, regarding specific fan power for fan coil systems.

NB: If you change the HVAC system defined in your project from one that provides mechanical ventilation to one that does not (or vice versa), you must re-visit the Ventilation sub-tab of the Zones tab in the Building Services form for all the zones served by this HVAC System in order for all ventilation-related parameters to be updated by the tool. You may also wish to re-define whether the ventilation is natural or mechanical in these zones following the change in the HVAC type.

If mechanical supply & extract is selected, the following fields become enabled:

a. Do you know the supply & extract specific fan power? - Here you can either use the default value or enter your own SFP for the zonal mechanical ventilation system, in W/(l/s). The SFP of an air distribution system is defined as the sum of the design total circuit-watts, including all losses through switchgear and controls, such as inverters, of the fans in the system that supply air and extract it back outdoor (i.e. the sum of the total circuit-watts of supply and extract fans), divided by the design air flow rate through the system. For further details on the SFP and how it is calculated, see the Non-Domestic HVAC Compliance Guide. **NB:** The default value may not comply with the current Building Regulations.

Heat recovery

b. Heat recovery – Here you need to select from: No heat recovery, Plate heat exchanger (Recuperator), Heat pipes, Thermal wheel, and Run around coil (see Table 12 for brief descriptions of the options).

c. Heat recovery seasonal efficiency - This parameter is active if a heat recovery system is selected, i.e., the previous parameter is not set to 'No heat

[xvi] For details, please refer to BS 5925:1991: Code of Practice for Ventilation Principles and Designing for Natural Ventilation.

recovery'. If you know the heat recovery efficiency, it can be introduced manually into the interface. Otherwise, a default value will be used by SBEM.

NB: If the SFP was calculated or measured for a mechanical ventilation system that already included heat recovery, then that is the value you enter into iSBEM. If the SFP was calculated or measured for a mechanical ventilation system before a heat recovery system was added on, then you need to add 0.15 to the SFP for a thermal wheel system, and 0.3 for any of the other heat recovery options in iSBEM, to account for the additional resistance.

d. Demand-controlled ventilation – This field will become active in future versions and will allow the user to specify demand-controlled ventilation.

2. Does the activity area require high pressure drop air treatment? – This option caters for activities that inherently demand the use of high pressure drop air treatment, including HEPA filtration. This may occur in hospitals (areas such as operating theatres and intensive care suites), airports (to keep aviation fumes out), some museums and libraries (with sensitive exhibits), commercial kitchens (odour filters, grease traps, filters to protect the odour filters, etc.), some industrial processes, and in buildings designed to withstand a biological attack. Here, you can either let SBEM take this parameter from the NCM activity database or you can select to tick or untick the relevant box manually.

   NB: If you do tick the box manually, you may be expected to provide justification to your claim for high pressure drops to building control.

Figure 67 shows a zone's ventilation characteristics being defined.

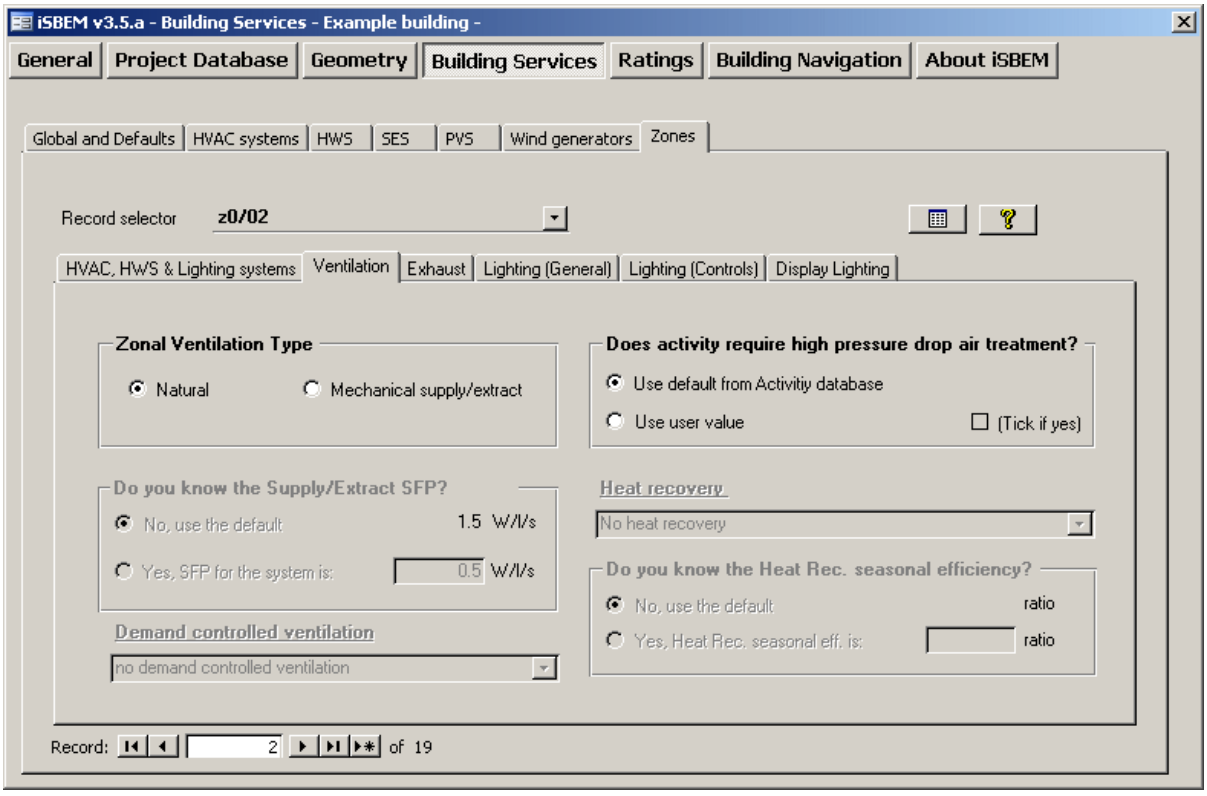


Figure 67: Defining the zone ventilation in the Ventilation sub-tab

Exhaust sub-tab:

This sub-tab is used to specify the characteristics of a mechanical exhaust system in the zone. The following information is required:

Local Mechanical Exhaust

1. Is there mechanical exhaust in the zone? – An example of when this would be used is in a toilet. This tick box is enabled for all types of HVAC systems serving the zone.

   If the above tick box is ticked (i.e., there is mechanical exhaust in the zone), then the following fields become active:

   a. Local mechanical exhaust - This is the flow rate of air leaving the zone, in l/s.m^2 of floor area. Guidance on typical figures for this parameter could be found in CIBSE Guide F Part A (Table 7.2, Basic fan capacity benchmarks). **NB:** iSBEM requires the exhaust flow rate in l/(s.m^2) of floor area while the values in the CIBSE Guide are given in l/(s.m^3). Use the zone height to convert the CIBSE values into the units required by iSBEM.

   b. Do you know the exhaust specific fan power? - Here you can either use the default value or enter your own SFP for the zonal mechanical exhaust system, in W/(l/s). **NB:** The default value may not comply with the current Building Regulations.

   c. Scope of exhaust system – Here you can use the radio buttons to specify whether the exhaust fan is remote from the zone (i.e., the exhaust system serves multiple spaces) or within the zone (i.e., a local window/wall/roof unit such as in a toilet).

Figure 68 shows a zone's exhaust characteristics being defined.

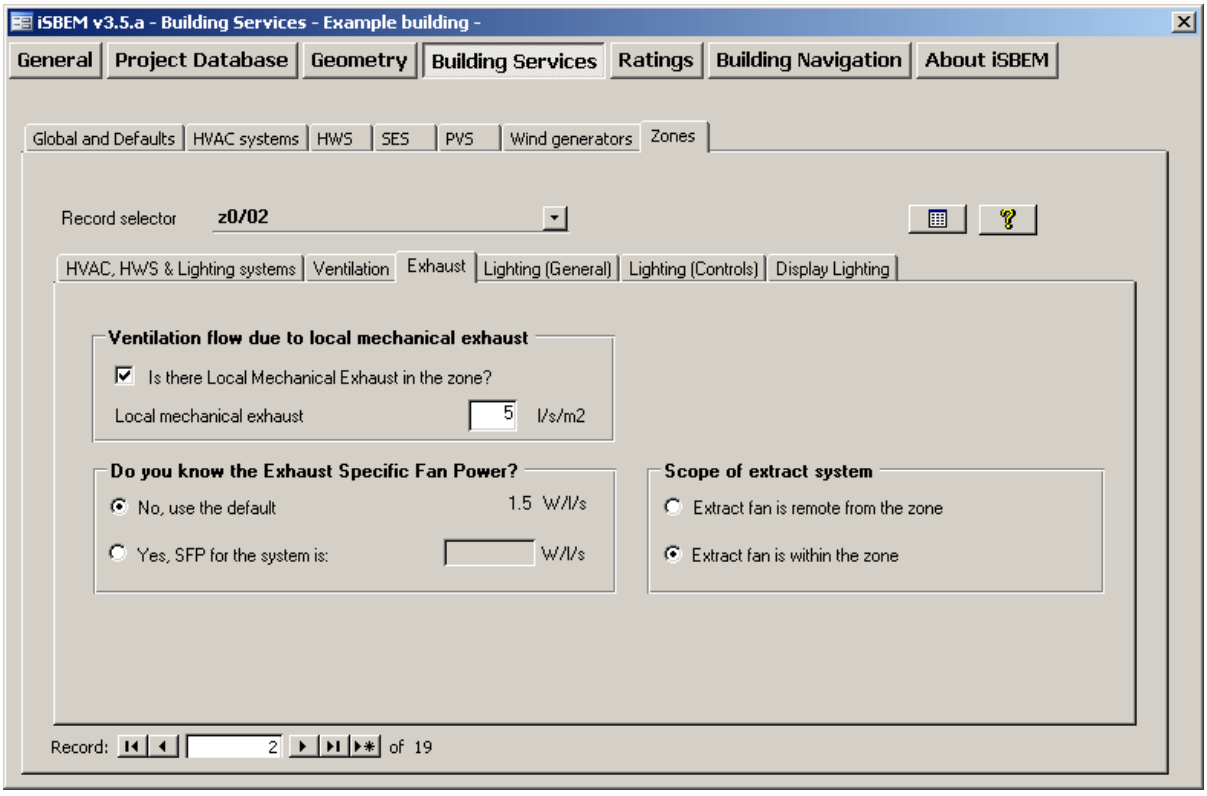


Figure 68: Defining the zone mechanical exhaust in the Exhaust sub-tab

Lighting (General) sub-tab:

In the Lighting (General) sub-tab, each zone needs to be selected in turn and the following data entered:

1. What information is available on lighting? – Here, you need to choose from: Full lighting design carried out (where you need to enter the total wattage in Watts and the design illuminance in lux for that zone – usually available from the lighting design engineer for a new building), Lighting chosen but calculation not carried out (where you need to specify the average initial (100 hour) lamp plus ballast efficacy for the lighting in the zone in lumens per circuit-Watt), or Lighting parameters not available (where you need to choose the lamp type from a drop-down list) – usually for existing buildings. The power density used by SBEM when each of the lamp types is selected is shown in Table 15. If you cannot find your lamp type on the list, you can select the one with the closest power density. For example, low voltage tungsten halogen (which have a typical power density = 24 W/m^2 per 100 Lux) can be approximated by selecting tungsten lamps (which have a typical power density = 28 W/m^2 per 100 Lux) instead in iSBEM.

NB: If you select 'Full lighting design carried out' or 'Lighting chosen but calculation not carried out' and enter the required parameters, you will now also need to select the type of lamps used in the zone (for the purposes of generating the recommendations report for the EPC).

NB: If you do not know the type of lamps in the zone, you should select the option of 'Don't know' in the "Lamp Type" parameter (SBEM will assume that they are tungsten lamps). If you know that the lamps are fluorescent but have no further details, you should select the option 'Fluorescent (No details)'.

Lamp Type	Power Density in W/m^2 per 100 Lux	
	Commercial Application	Industrial Application
Tungsten lamp	28	-
Fluorescent - compact	4.6	-
T12 Fluorescent - halophosphate - low frequency ballast	5	3.9
T8 Fluorescent - halophosphate - low frequency ballast	4.4	3.4
T8 Fluorescent - halophosphate - high frequency ballast	3.8	3
T8 Fluorescent - triphosphor - high frequency ballast	3.4	2.6
Metal Halide	5.5	4.1
High Pressure Mercury	7.6	5.7
High Pressure Sodium	4.5	3.3
T5 Fluorescent - triphosphor-coated - high frequency ballast	3.3	2.6
Fluorescent (no details)	5	5
Don't know	28	28

Table 15: Power densities used by SBEM in correspondence to the lamp types selected

NB: The total wattage value that is entered into iSBEM is for the lighting system, i.e., it should include the luminaires and ballasts (control gear).

NB: The design illuminance, in lux, is that for which the full lighting design has been carried out. The maintained illuminance at the end of the lamp life and before cleaning of the luminaires should not be less than the design illuminance. This value will be used, along with the total wattage value, in order to determine the consequent power density values associated with the lighting system used in W/m^2 per 100 lux. This value will, in turn, be used to calculate the electrical consumption of an equivalent system which delivers the illuminance levels specified in the database. The calculated lighting energy consumption will be higher or lower than you expect depending on whether the design illuminance entered is higher or lower than the database illuminance for the activity. Changing the activity in a zone will change the corresponding illuminance retrieved from the Activity database, which would be reflected in both the actual and notional buildings. You can download the NCM Activity

Database from the NCM website if you wish the view the illuminance values associated with each activity type.

NB: The lighting option of "Lighting chosen but calculation not carried out" is not available in SBEM for office, industrial, and storage areas in all building types, as the compliance criteria for these spaces are measured in luminaire-lumens per circuit-watt (rather than lamp-lumens/circuit-watt). Please refer to the Approved Document L2A for details.

2. Are air-extracting luminaires fitted? – Select: Yes or No/don't know.

Figure 69 shows the lighting characteristics of a zone being defined.

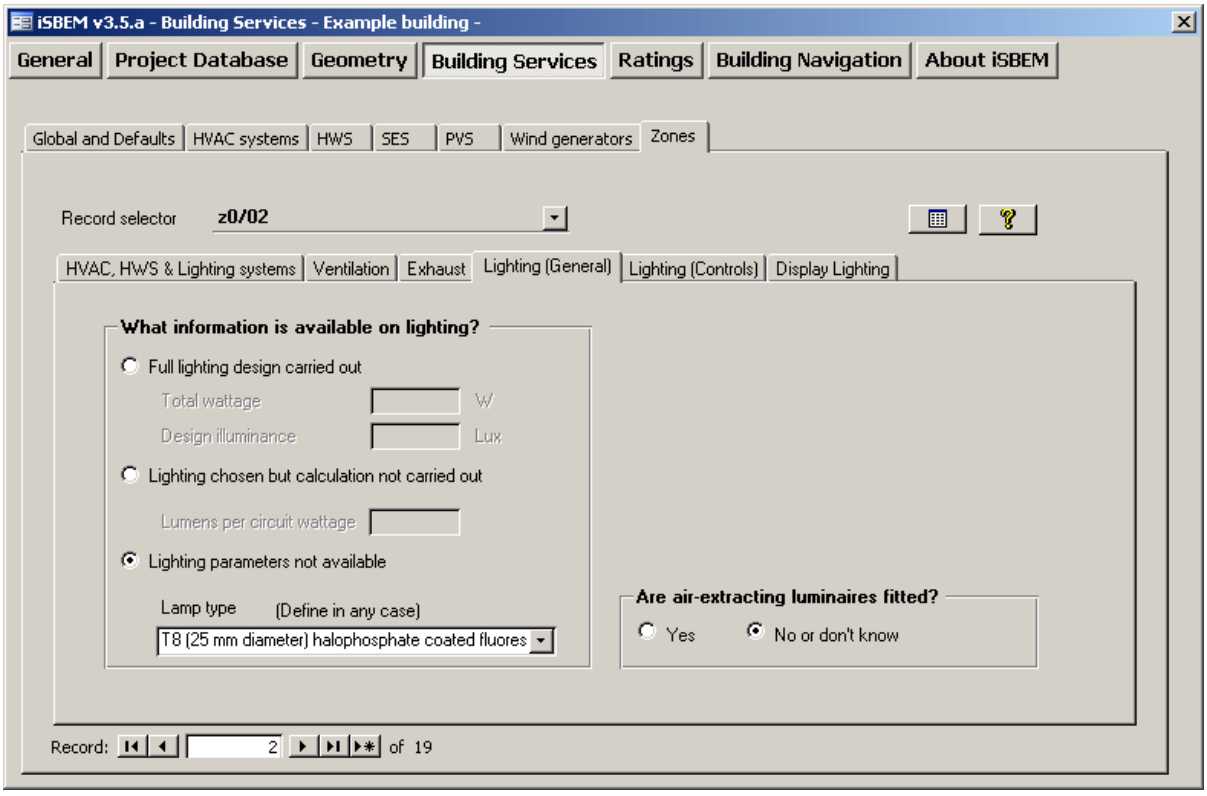


Figure 69: Defining the zone lighting characteristics in the Lighting (General) sub-tab

Lighting (Controls) sub-tab:

In this sub-tab, each zone needs to be selected, and the controls relating to its lighting need to be defined:

1. Light controls - Here you need to indicate whether there are: No local controls (i.e., the lighting is centrally controlled according to the occupancy schedules from the NCM Activity Database for the activity selected for this particular zone), Local manual switching, and/or Photoelectric controls present by ticking none, both, or one of the two tick boxes, respectively. Local manual switching is where the occupants can control their own luminaries individually, and each light switch must be less than six metres from the luminaries it controls (it could be a hand held controller such as infra-red).

   If the "Photoelectric option" is ticked, the following fields become active:

   a. Photoelectric options - Here you need to choose between: Switching and Dimming.

b. Indicate whether there is a different sensor to control the lighting in the back half of the zone (tick box), i.e., the half furthest from the window.

c. Select the type of photoelectric sensors from the available options: Stand-alone sensors or (Digitally) Addressable systems.

d. Parasitic power for photoelectric controls – Enter the parasitic power consumption of the photoelectric system in W/m^2 if you know it. Otherwise, the following defaults will be used: 0.3 W/m^2 if the previous field is selected as "Stand-alone sensors", and 0.57 W/m^2 if "Addressable systems" is selected (digitally addressable systems are for special applications and are not particularly energy efficient).

NB: Values for the parasitic power need to be reasonable. Otherwise, the benefits due to the use of photoelectric controls may be negated by the extra electrical consumption required by the controls equipment.

2. Automatic daylight zoning for lighting controls? – This parameter is active if one or both of the above tick boxes on lighting controls are ticked. If you select 'Yes', then SBEM will automatically sub-divide the zone into daylighting zones, if needed, following the zoning rules for zones with windows and rooflights, and you do not need to sub-divide it yourself. If you select 'No', then you need to specify the percentage area of the zone where the lighting is controlled so as to respond to daylight (whether by a photosensor or manual control). If that percentage is 100%, this means that the whole area of the zone has lighting controls that respond to daylight, and SBEM will perform no further sub-divisions for this zone, i.e., you have already done the sub-division manually yourself. If the percentage value that you enter is less than 100%, for e.g., 70%, then SBEM will sub-divide the zone into two daylight zones whose areas are 70% and 30% of the total area of the zone, respectively. SBEM will then consider that the 70% daylight area will have lighting controls responding to daylight while the lighting in the 30% daylight area will not be affected by daylight.

   NB: If your zone has a non-typical layout of windows and/or rooflights, and you are worried that SBEM's automatic sub-division might not correctly reflect the access to daylight in the zone, it is recommended that you carry out the daylighting sub-division yourself, as with previous iSBEM versions.

3. Occupancy Sensing – Here, you need to select what kind of occupancy sensing the zone has, if applicable, from the available options shown in Table 16. **NB:** If there is no manual light switching defined in the zone, then the occupancy sensing options are restricted to: AUTO-ON-DIMMED and AUTO-ON-OFF only. If occupancy sensing is available in the zone, the following field becomes active:

   a. Parasitic power for occupancy sensing – Enter the parasitic power consumption of the occupancy sensing in W/m^2 if you know it. Otherwise, the default value of: 0.3 W/m^2 will be used.

   NB: Values for the parasitic power need to be reasonable. Otherwise, the benefits due to the use of occupancy sensing may be negated by the extra electrical consumption required by the controls equipment.

Type of Occupancy Sensing Control	Brief Description
MAN-ON-OFF+EXT	Lights manually switched on and off, with the addition of an automatic extinction signal.
AUTO-ON-DIMMED	Lights automatically switched on whenever people enter a room and dimmed to a low level when no movement has been detected for a set time (usually 5-15 minutes).
AUTO-ON-OFF	Lights automatically switched on whenever people enter a room and switched off when no movement has been detected for a set time (usually 5-15 minutes).

MAN-ON-DIMMED	Lights manually switched on and automatically dimmed to a low level when no movement has been detected for a set time (usually 5-15 minutes).
MAN-ON-AUTO-OFF	Lights manually switched on and automatically switched off when no movement has been detected for a set time (usually 5-15 minutes).
NONE	No occupancy sensing

Table 16: Types of occupancy sensing controls available in iSBEM

Figure 70 shows the lighting controls in a zone being defined.

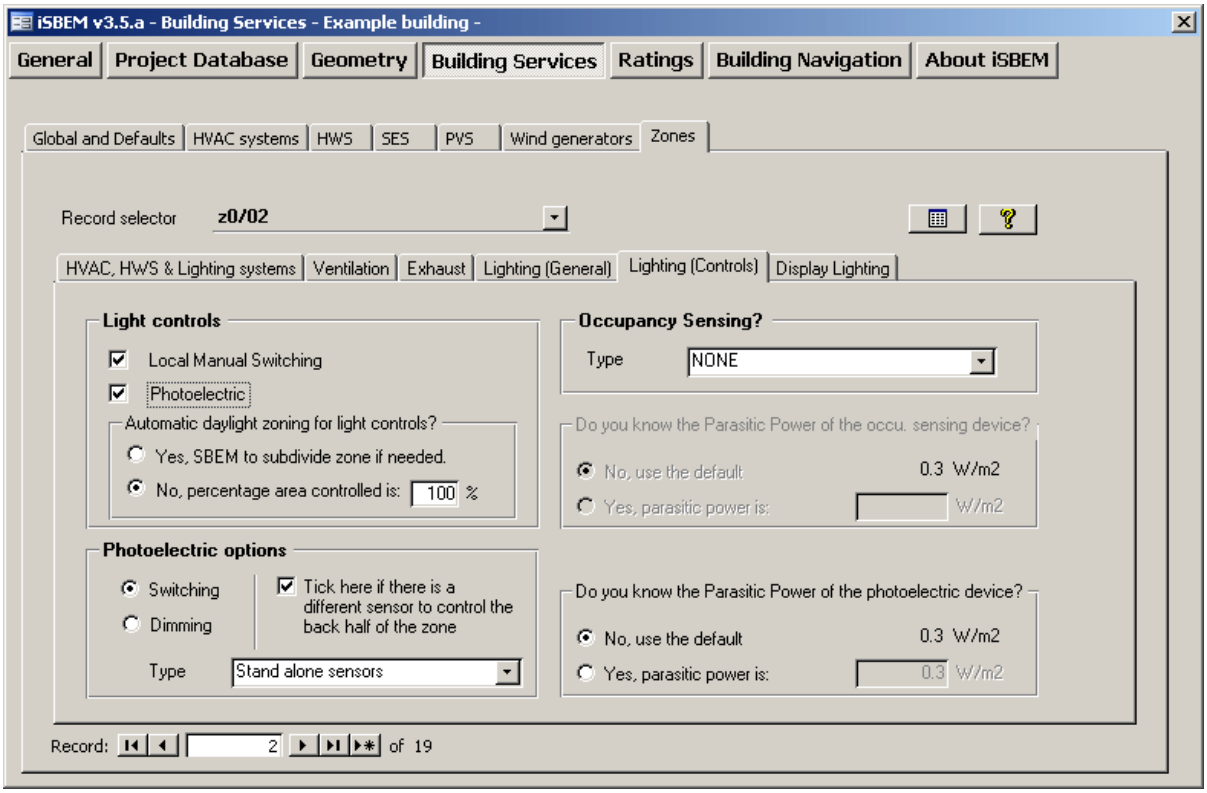


Figure 70: Defining the lighting controls characteristics of a zone

Display Lighting sub-tab:

This sub-tab is active for a particular zone only if by nature of the activity selected for the zone, display lighting is applicable, e.g., retail. In the Display Lighting sub-tab, each zone needs to be selected in turn and the following data entered:

1. Does display lighting use efficient lamps? – Select: Yes or No/don't know. If "Yes" is selected, then the average lamp and ballast efficacy in lamp-lumens per circuit wattage needs to be entered for the display lighting (only applies if there is display lighting in the space by nature of its selected activity).

   NB: For the purposes of the lighting calculations in SBEM, efficient display lighting is one with a lamp and ballast efficacy better than 15 lamp-lumens per circuit-Watt. Examples of efficiency display lighting lamps include: metal halide, compact fluorescent, and white SON (high pressure sodium).

2. Time Switching for display lighting (only applies if there is display lighting in the space by nature of its selected activity, e.g., retail) – Here, you need to choose between: None,

Dimming, or Switching. If either Dimming or Switching is chosen, the following parameters become active, and you then need to enter the “Hours off” and “Fraction off” parameters.

a. Hours off - If switching is selected, the hours off specifies the number of hours per average day during which the display lighting is switched off. If dimming is selected, the hours off specifies the number of hours per average day during which the display lighting is dimmed.

b. Fraction off – If switching is selected, the fraction off parameter specifies the fraction of display lighting which is turned off by the time switch. If this is 1, all the display lighting is switched off by the time switch. If dimming is selected, the fraction off specifies the fraction of display lighting which is dimmed by the time switch.

Figure 71 shows the display lighting characteristics and controls for a zone being defined.

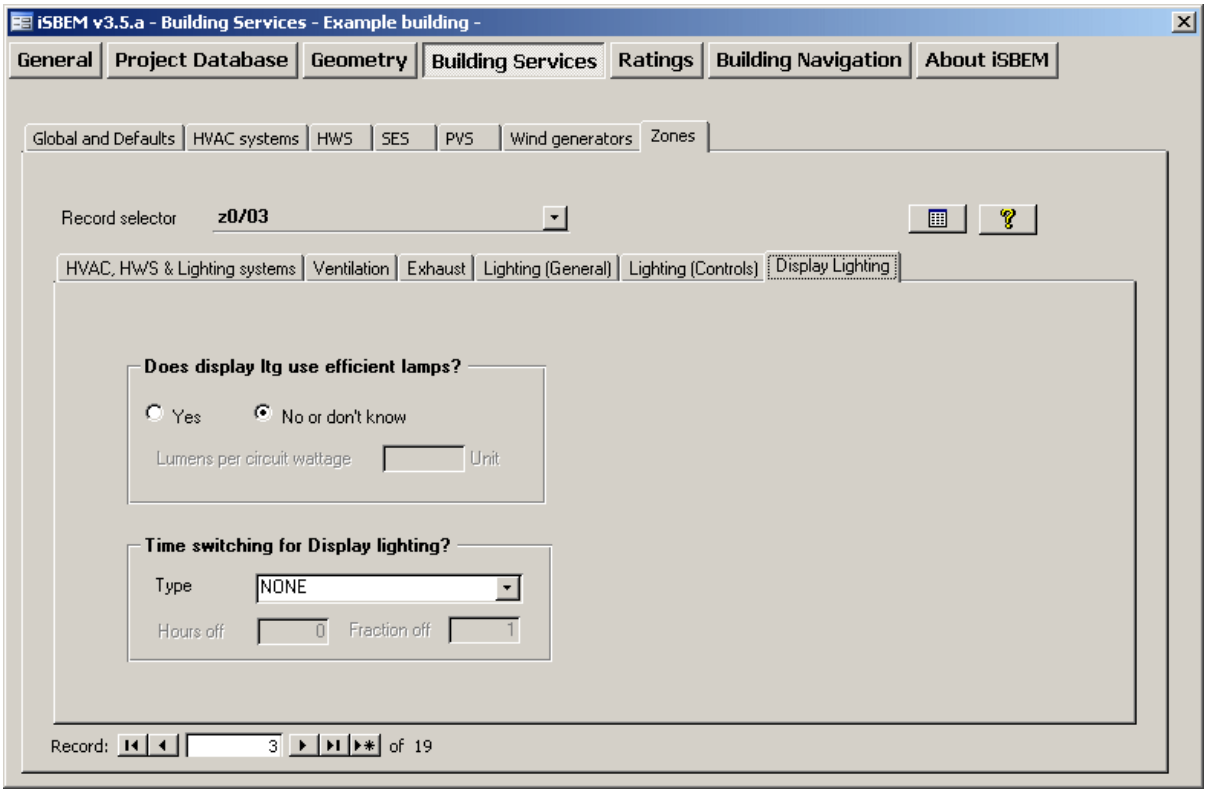


Figure 71: Defining the zone display lighting in the Display Lighting sub-tab

Task 16: Assign each zone to the appropriate HVAC and HWS, and define the ventilation and lighting strategies for each of the zones

Details can be found in APPENDIX A:, Section A.2: Systems. For each zone, click into the *Zones* tab in the *Building Services* form. Select each of the zones in turn using the record selector, and enter the required information.

7.7. Building Navigation form

This form allows the user to navigate through the project in order to view summaries of the different types of building objects that have been defined, as well as some detailed information about individual objects. This form contains 2 tabs:

1. **Selections** tab
2. **Object Properties** tab

7.7.1. Selections tab

In this tab (Figure 72), depending on which radio button is selected in the 'Objects' section, you can choose to view either: HVAC systems only, HVAC systems and zones only, HVAC systems, zones, and envelopes only, or HVAC systems, zones, envelopes, windows, and doors. Depending on which radio button is selected in the 'Assignment Status' section, you can choose to view either: Assigned objects only, Unassigned objects only, or both. Also, by ticking the box in the 'Objects' section, you can choose to also view other building objects, such as constructions, HWSs, SES, etc. The objects are then listed in the left hand side 'Object Tree' window in terms of their names and types. The 'Key to Objects' section contains the key to the symbols used to denote the types of objects.

There is a 'Refresh' button which you can click on in order to manually initiate the refreshing of the contents of the *Building Navigation* form, if the relevant tick box in the *General* form > *File Options* tab > *System Configuration* sub-tab is unticked. It the box is ticked, the contents of the *Building Navigation* form will be refreshed automatically with any changes in the objects properties that might have been performed since the form was last accessed (see Section 7.3.1: File Options tab).

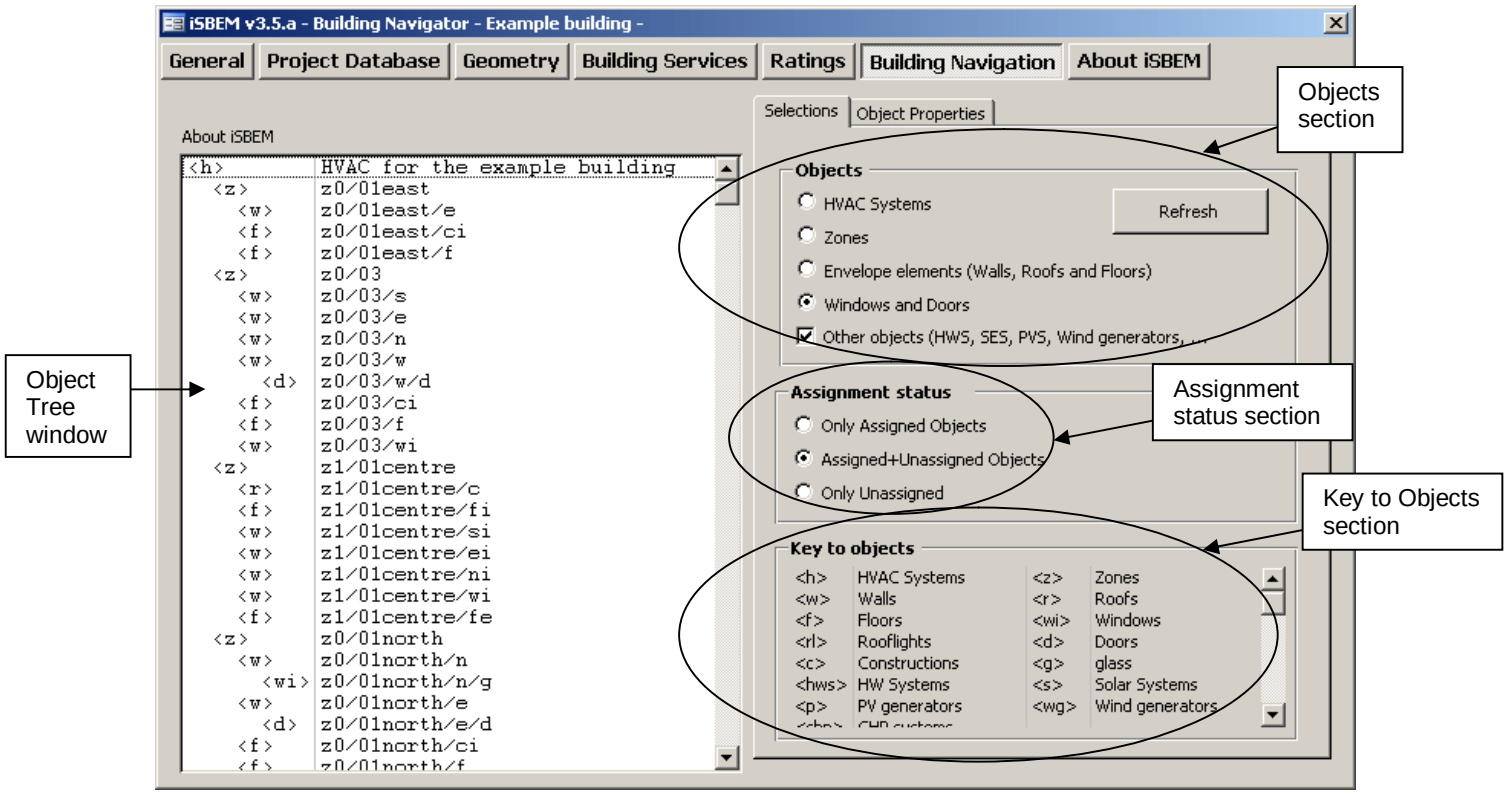


Figure 72: Selections tab in the Building Navigation form

7.7.2. Object Properties tab

In this tab (Figure 73), if any of the objects listed in the 'Object tree' window is highlighted, more details about that object's properties appear in the 'Objects properties' window on the right. For example, if the highlighted object is an envelope, the details displayed will be its area, construction, and the condition of the adjoining space, etc.

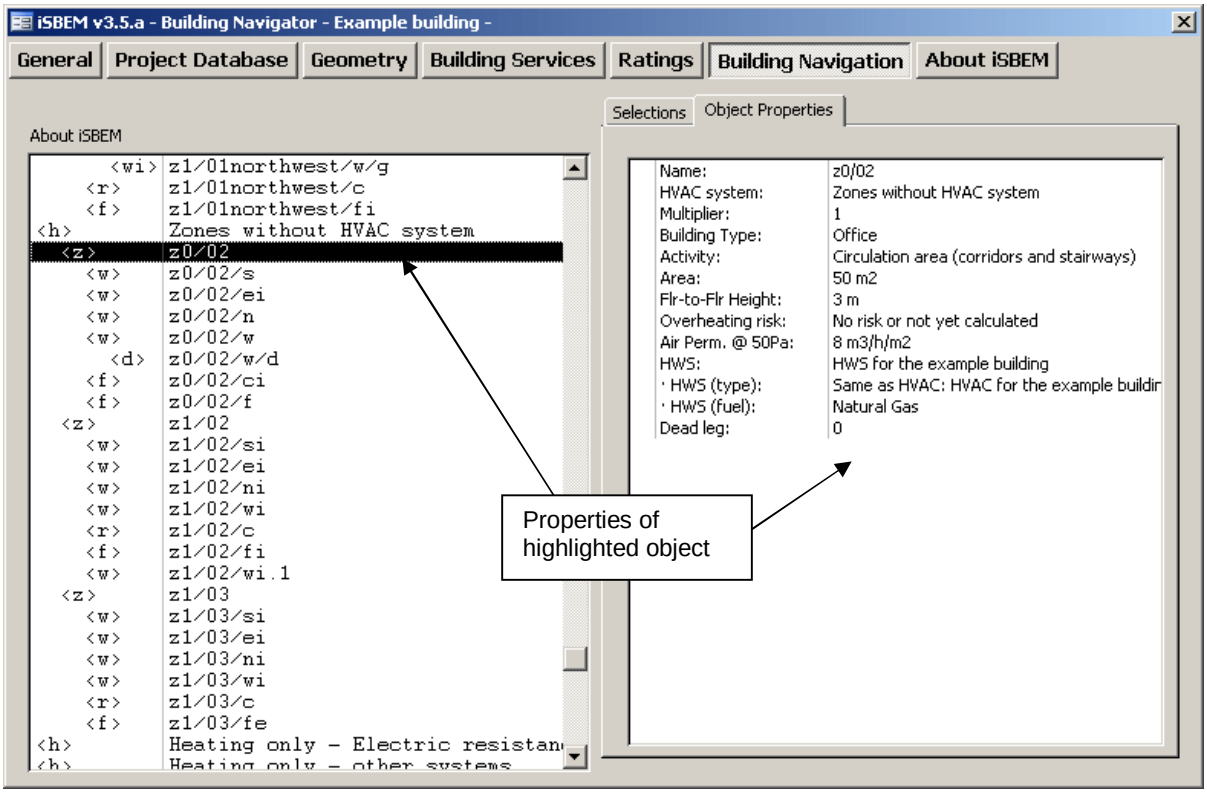


Figure 73: Objects Properties tab in the Building Navigation form

NEW

7.8. About iSBEM form

This form displays information about the SBEM software, licensing conditions, and acknowledgement. There is no data entry in this form.

7.9. Double-checking the data

It is advisable to always double-check the data entered for any project, in order to ensure that the building is modelled correctly, before running the energy performance calculation and compliance checking. There are several tools within iSBEM to facilitate this:

- **The Objects reports** - These reports can be accessed from all of the forms in the interface by pressing the *Object Reports* button: This can be found at the top right-hand side of all the tabs in the *Project Database*, *Geometry*, and *Building Services* forms, the bottom of the *Asset Rating* tab in the *Ratings* form, and in the *File Options* tab in the *General* form. There are two reports available in iSBEM to help the users check their data entry.

  1. **The Unassigned Objects report** which lists all the objects which have been created/defined but not assigned.

2. **The Data Summary report** which provides a hierarchical summary of all the building objects that have been defined and assigned along with key details on some of the objects.

- **The Assigned sub-tabs** - Wherever objects in iSBEM require that they be assigned to another object, there is usually a sub-tab which lists which objects have been assigned.
- **The Summary sub-tabs** – Similar to the *Assigned* sub-tabs used for objects defined in the *Geometry* form.
- **The Building Navigation form** – Provides a hierarchical summary of all the objects that have been defined in the project, assigned and unassigned, along with key details on some of the objects.

7.9.1. The Unassigned Objects Report

The *Unassigned Objects* Report is a simple list of all the objects which have been created but not assigned. They are grouped into two categories: *Unassigned Building Objects* and *Other Unassigned Objects*.

The *Unassigned Building Objects* (in **red** text) include all the zones, envelope elements, windows, doors, HVAC systems, HWSs, and SESs that have been created in iSBEM but not assigned. These are critical unassignments.

The *Other Unassigned Objects* (in **blue** text) include any construction or glazing types which have been created but not assigned to any of the envelope elements, windows, or doors. These are non-critical unassignments.

Figure 74 shows that there are 4 zones which have not been assigned to an HVAC system. The user would then need to go into the *Zones* tab in the *Geometry* form (or the *Zones* tab in the *Building Services* form) to assign each zone to an HVAC system. The figure also shows that there are no non-critical unassignments.

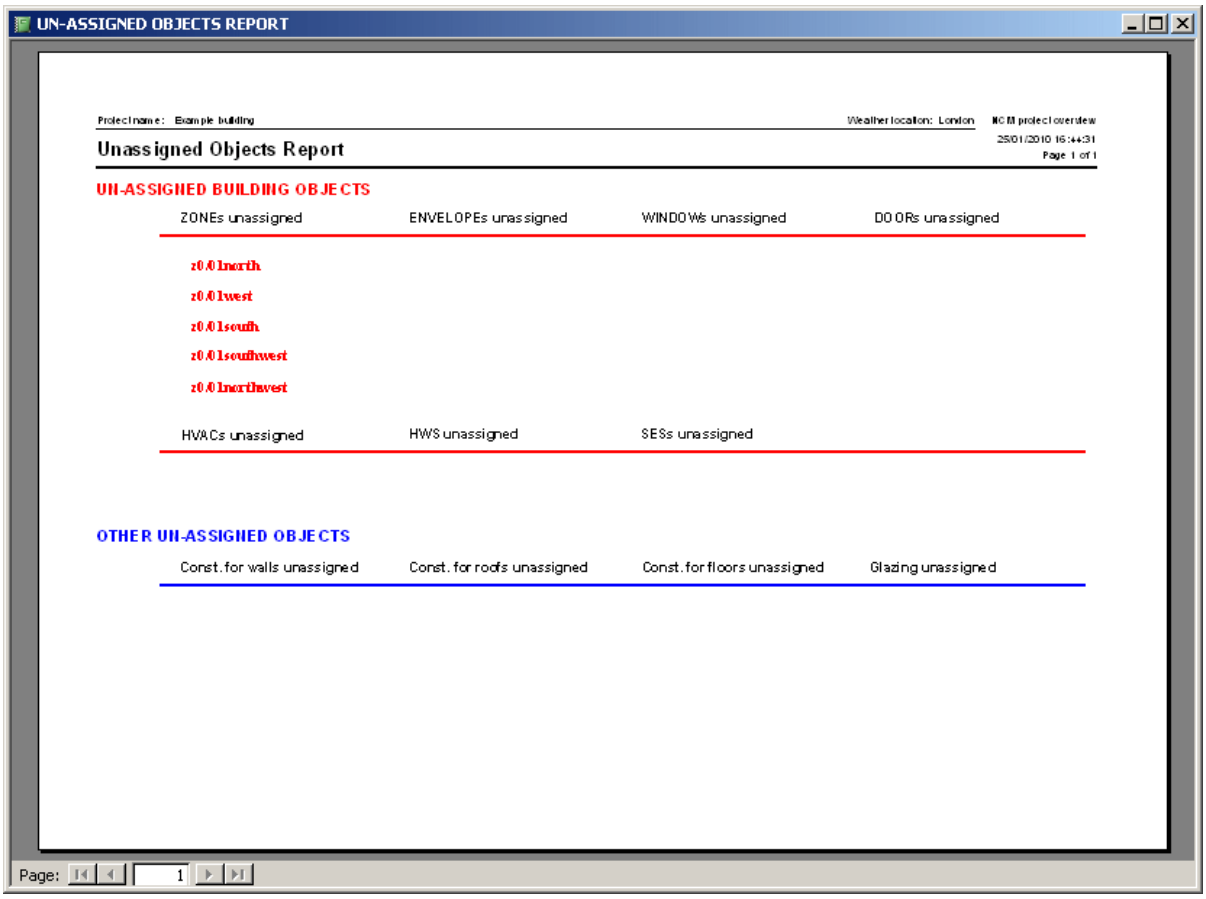


Figure 74: The Unassigned Objects Report

7.9.2. The Data Summary Report

The *Data Summary* Report has a double layer structure:

The first layer is in **black** text and is a tree structure of all the building objects that have been defined and assigned, reflecting the hierarchical relationship of the building objects (HVAC -> Zone -> Envelope -> Window / Door / Envelope Thermal bridge).

The second layer is in **blue** text and provides key information about each of the listed objects.

The assignment tree structure (black):

The first column lists the HVAC system status of the zone, the highest element in the hierarchy. The next column lists all of the zones that are assigned to that HVAC system. All the zones that have no HVAC system are listed first (see Figure 75) followed by those that do (Figure 76). The next column lists all of the zone's envelope elements, followed by the envelope elements' additional thermal bridges, windows, the windows' additional thermal bridges, and finally any doors with their additional thermal bridges.

Summary information (blue):

To the right of each zone, envelope element, and window (door) name is a selection of its key parameters/details. For example, to the right of any zone, you will find its activity type and its area. To the right of an envelope element, you will find which type of envelope it is (wall, roof, ceiling/floor), what sort of space it adjoins, its construction type, and its area. To the right of a window, you will find its glazing type and its area, and for a door, its construction and its area.

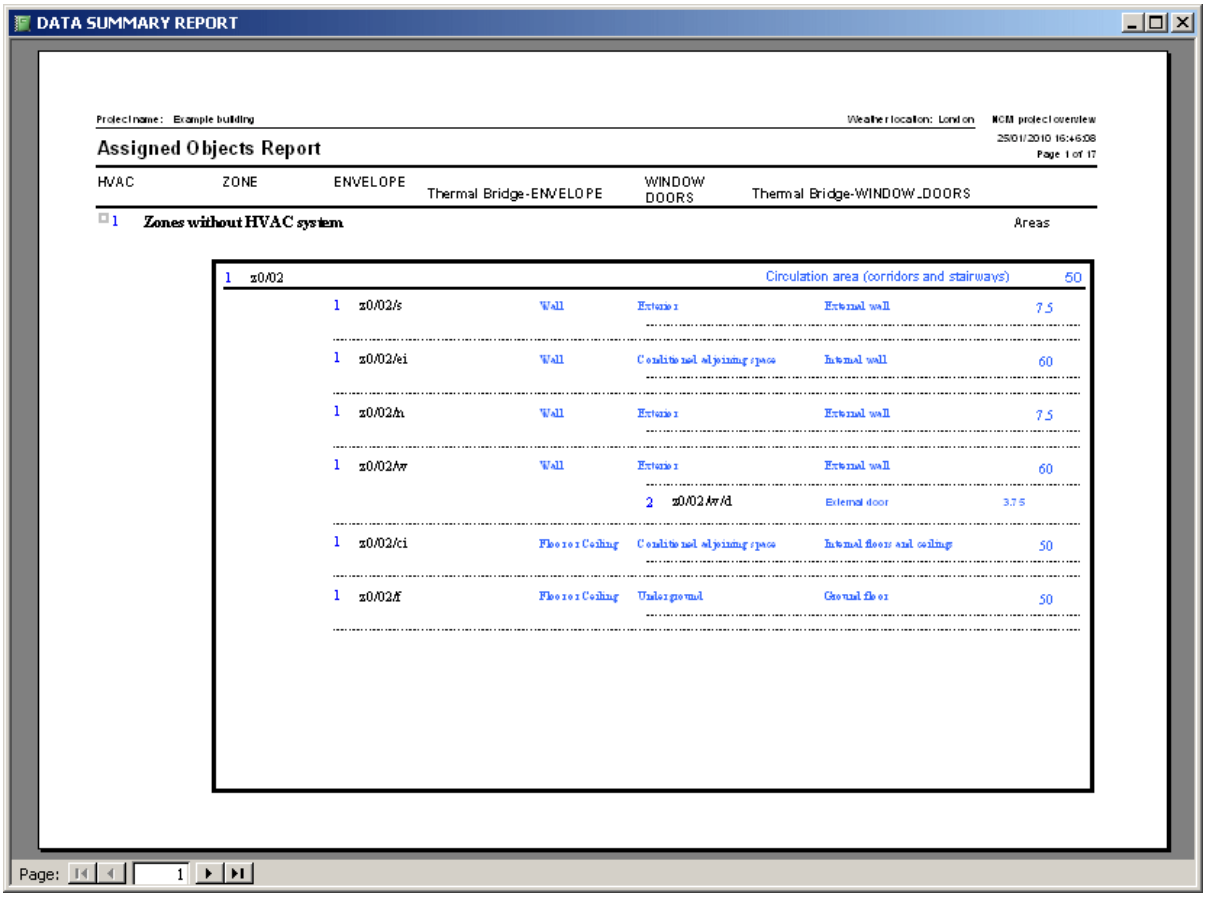

DATA SUMMARY REPORT
Project name: Example building
Weather location: London
HCM project overview
25/01/2010 16:46:08
Page 1 of 17
Assigned Objects Report
HVAC
ZONE
ENVELOPE
Thermal Bridge-ENVELOPE
WINDOW DOORS
Thermal Bridge-WINDOW_DOORS
1 Zones without HVAC system
Areas
1 z0/02 Circulation area (corridors and stairways) 50
1 z0/02/s Wall Exterior External wall 7.5
1 z0/02/ei Wall Conditioned adjoining space Internal wall 60
1 z0/02/n Wall Exterior External wall 7.5
1 z0/02/w Wall Exterior External wall 60
2 z0/02/w/d External door 3.75
1 z0/02/ci Floor or Ceiling Conditioned adjoining space Internal floor and ceiling 50
1 z0/02/f Floor or Ceiling Underground Ground floor 50
Page: 1

Figure 75: Data Summary Report: Zones without HVAC

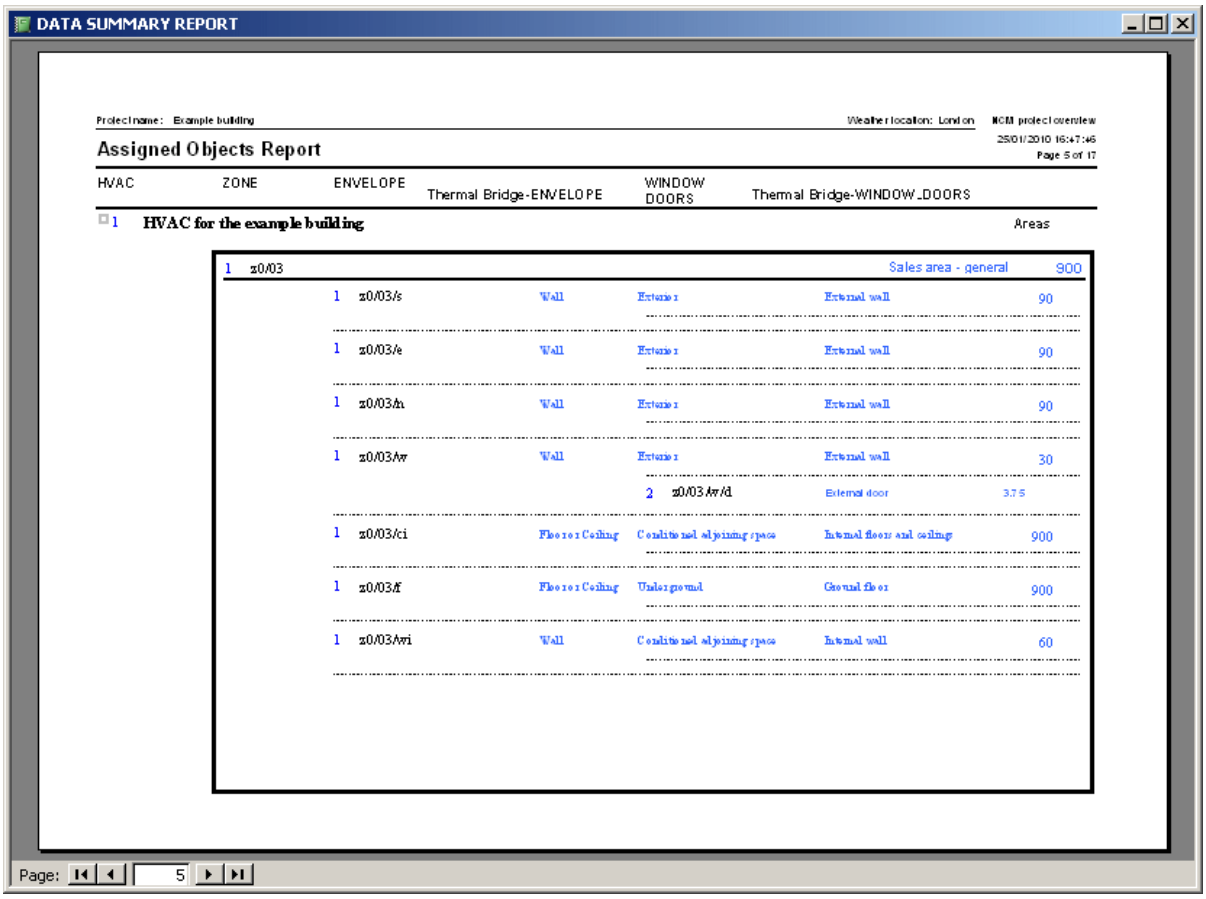

DATA SUMMARY REPORT
Project name: Example building
Weather location: London
HCM project overview
25/01/2010 16:47:46
Page 5 of 17
Assigned Objects Report
HVAC
ZONE
ENVELOPE
Thermal Bridge-ENVELOPE
WINDOW DOORS
Thermal Bridge-WINDOW_DOORS
1 HVAC for the example building
Areas
1 z0/03
Sales area - general 900
1 z0/03/s Wall Exterior External wall 90
1 z0/03/e Wall Exterior External wall 90
1 z0/03/n Wall Exterior External wall 90
1 z0/03/w Wall Exterior External wall 30
2 z0/03/w/d External door 3.75
1 z0/03/ci Floor or Ceiling Conditioned adjoining space Internal floors and ceilings 900
1 z0/03/f Floor or Ceiling Underground Ground floor 900
1 z0/03/wi Wall Conditioned adjoining space Internal wall 60
Page: 5

Figure 76: Data Summary Report: Zones with HVAC

Task 17: Check your data entry and assignments using the Data Summary report and Unassigned Objects Report

Now that all the zones have been assigned to HVAC systems, they should all appear in the *Data Summary* Report. Click on the *Objects Report* button in the top right hand corner of any of the sub-tabs and view the *Assigned Objects* Report. You should now be able to see the hierarchy of the building objects you have created. The HVAC system should have 16 zones assigned to it. Each zone should have its respective walls, floors, ceilings/roofs assigned and certain walls should have windows and/or doors assigned. Double-check that the assignments are correct before proceeding.

7.9.3. The Assigned sub-tabs

The *Assigned* sub-tabs display the parent objects which the object in question has been assigned to. There are six *Assigned* tabs in the interface:

- **The Walls Assigned sub-tab** - in the *Project Database* form > *Construction for Walls* tab - displays all of the envelopes to which the wall construction selected in the record selector has been assigned.
- **The Floors Assigned sub-tab** - in the *Project Database* form > *Construction for Floors* tab - displays all of the envelopes to which the floor construction selected in the record selector has been assigned.
- **The Roofs Assigned sub-tab** - in the *Project Database* form > *Construction for Roofs* tab - displays all of the envelopes to which the roof construction selected in the record selector has been assigned.

- **The Glazing Assigned sub-tab** - in the *Project Database* form > *Glazing* tab - displays all of the windows or rooflights to which the glazing selected in the record selector has been assigned.
- **The Doors Assigned sub-tab** - in the *Project Database* form > *Construction for Doors* tab - displays all of the doors to which the door construction selected in the record selector has been assigned.
- **The HWS Assigned sub-tab** - in the *Building Services* form > *HWS* - displays all of the zones to which the HWS selected in the record selector has been assigned.

All the above *Assigned* tabs cannot be edited. They are for viewing only.

7.9.4. The Summary sub-tabs

The *Summary* sub-tabs show which sub-objects have been assigned to the object in question. There are three *Summary* sub-tabs in the interface:

- **The Envelopes Summary sub-tab** - in the *Geometry* form > *Zones* tab shows which envelopes have been assigned to each respective zone (see Section 7.5.3: Defining zones).
- **The Windows & Doors Summary sub-tab** - in the *Geometry* form > *Envelopes* tab shows which windows and doors have been assigned to which envelope (see Section 7.5.4: Defining envelopes – Envelope tab).
- **The Zone Summary sub-tab** - in the *Building Services* form > *HVAC Systems* tab shows which zones have been assigned to which HVAC system (see Section 7.6.2: Defining HVAC Systems).

Task 18: Check your data entry and assignments using the Summary and Assigned sub-tabs

Double-check that the assignments are correct before proceeding.

8. CALCULATING AND VIEWING THE ENERGY PERFORMANCE OF THE BUILDING- THE RATINGS FORM AND OUTPUT REPORTS

The energy performance of the building is calculated and compliance with the building regulations is assessed (or the Energy Performance Certificate generated) via the *Ratings* form. The key results are then displayed in this form. Further details on Building Regulations compliance and a more detailed analysis of the energy used and CO_2 emitted from the building are given in the SBEM output reports. This chapter describes how to calculate the results and access the various outputs.

8.1. The Ratings form

The *Ratings* form allows the user to:

1. Run the entered building model through SBEM and the Compliance Checking Module (BRUKL) to calculate the energy consumption and CO_2 emissions of the building (and those of the notional building) and determine whether it complies with Building Regulations (if either 'England and Wales Building Regulations Part L', 'Scottish Building Regulations', or 'Northern Ireland Building Regulations Part F' were selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab). You can do this by pressing the "Check Regulations" button in the *Building Regulations Check* tab > *Building Rating* sub-tab.

   or (depending on the "Purpose of Analysis" selection in the *General* form > *General Information* tab > *Project Details* sub-tab)

2. Run the entered building model through SBEM and the Energy Performance Certificate Generator Module (EPCgen) to calculate the energy consumption of the building, CO_2 emissions (and those of the notional, reference, and typical buildings), and its EPC Asset Rating (if 'EPC England', 'EPC Wales', 'EPC Scotland', or 'EPC Northern Ireland' were selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab). You can do this by pressing the "Calculate EPC rating" button in the *Asset Rating* tab > *Building Rating* sub-tab.

NB: You will be able to monitor on the screen the progress of the calculation process as it is carried out for the different building objects.

3. View the key results within the interface.
4. Access the following output reports:
   - the *Building Regulations Compliance* document ('Specification Information' for Scottish Building Regulations), the *SBEM Main Output* report, and 2 *Data Reflection* Reports for the actual and notional buildings, if compliance with Building Regulations is the purpose of the analysis.
   - the *Energy Performance Certificate*, the *Recommendations Report*, the *SBEM Main Output* report, *SBEM Secondary Recommendations Report* and the *Data Reflection* Report for the actual building if generating the EPC is the purpose of the analysis.

The *Ratings* form is composed of one tab, which is either:

- **Building Regulations Check** tab: displays the CO_2 emissions, in kg per m^2 of building area, for the actual and notional buildings as well as the target, and an assessment of whether the building complies with the carbon dioxide emissions criterion of the Building

Regulations. It also displays a break-down of the annual energy consumption by end-use for both the actual and notional buildings in kWh/m^2.

or (depending on the "Purpose of Analysis" selection in the *General* form > *General Information* tab > *Project Details* sub-tab)

- **Asset Rating** tab: displays the CO_2 emissions, in kg per m^2 of building area, for the actual and typical buildings, part L target, and standard, along with their corresponding EPC bands. It also displays a break-down of the annual energy consumption by end-use for the actual, notional, and reference buildings in kWh/m^2.

8.1.1. Building Regulations Check tab

This tab is visible if either 'England and Wales Building Regulations Part L', 'Scottish Building Regulations', or 'Northern Ireland Building Regulations Part F' were selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab. The *Building Regulations Check* tab has four sub-tabs:

- **Building Rating** sub-tab
- **Calculation Logs** sub-tab
- **Calculation Errors** sub-tab

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- **Supporting Documents** sub-tab

Building Rating sub-tab:

Building Regulations compliance is assessed by clicking on the "Check Regulation" button in the *Building Rating* sub-tab. This initiates the data processing through the SBEM calculation engine and the Compliance Checking Module (BRUKL). The following calculated information is then displayed in this sub-tab as follows:

1. The energy used per square metre (kWh/m^2) annually by the actual building and the notional building for heating, cooling, auxiliary energy (pumps, fans, and controls), lighting, and hot water.
2. The total energy used per square metre (kWh/m^2) annually by the actual building and the notional building in terms of both electricity and fuel use.
3. The Actual Building Emission Rate (BER) – This is the annual CO_2 emissions per square metre for the actual building, in kgCO_2/m^2.
4. The Notional Building Emission rate – This is the annual CO_2 emissions per square metre for the notional building, in kgCO_2/m^2.
5. The Target Emission Rate (TER) – (kgCO_2/m^2) for details on the derivation of the TER, see Section 2.2: Calculation basics for UK Building Regulations compliance purposes. In summary, this is the Notional Building Emission Rate with the following two factors applied to it:
    a. IF (improvement factor)
    b. LZC (Low or zero carbon benchmark)
6. Pass CO_2 - If the BER$\leq$TER, the building passes the CO_2 emissions criterion of the building regulations. Otherwise, it does not.

Checks regarding other Building Regulations compliance criteria, such as U-Value checks and building services efficiencies checks can be found in the *Building Regulations Compliance* document (see Section 8.2.2: SBEM BRUKL Output Document: Compliance with Building Regulations) which can be accessed from the *Building Rating* sub-tab.

Also accessible from this sub-tab is the *Main SBEM Output* report and the *Data Reflection* Reports. See Sections 8.2.1: SBEM Main Output Document, 8.2.2: SBEM BRUKL Output

Document: Compliance with Building Regulations, 8.2.3: Data Reflection Report – Actual Building, and 8.2.4: Data Reflection Report – Notional Building.

NB: The Data Reflection Reports in html format are generated, and the related access buttons become visible in the *Ratings* form, only if the relevant box is ticked in the *General* form > *File Options* tab > *System Configuration* sub-tab.

NB: If any changes are made to a project, the "Check Regulation" button needs to be clicked on again on returning to this sub-tab in order to update the results as the results figures are not refreshed automatically.

NB: You must close all output files before re-running the calculation (so the software can over-write them). Otherwise, an error message will be produced.

Unassignment alert

If you have omitted to assign any objects in the interface, you will be notified at the bottom of both the *Building Regulations Check* and *Asset Rating* tabs. You will be able to view the *Unassigned Objects* Report by clicking on the 'Objects Report' button. You will see one of the following two messages at the bottom of the screen:

"Click to check object assignments, there are no CRITICAL un-assignments in this project".

"Please check (#) CRITICAL UNASSIGNMENTS before proceeding with final rating" (where # is the number of critical un-assignments in the project).

NB: CRITICAL refers to "building object" un-assignments rather than construction or glazing un-assignments.

Figure 77 shows the *Building Rating* sub-tab in the *Building Regulation Check* tab of the *Ratings* form for England and Wales and Figure 78 shows the same for Scotland. The message at the bottom of the screen indicates that there are no critical un-assignments in the project. If there were, the user would need to click on the "Objects Report" button, identify the un-assignment, make the correction in the appropriate part of iSBEM, then return to this page, and then click on the "Check Regulation" button.

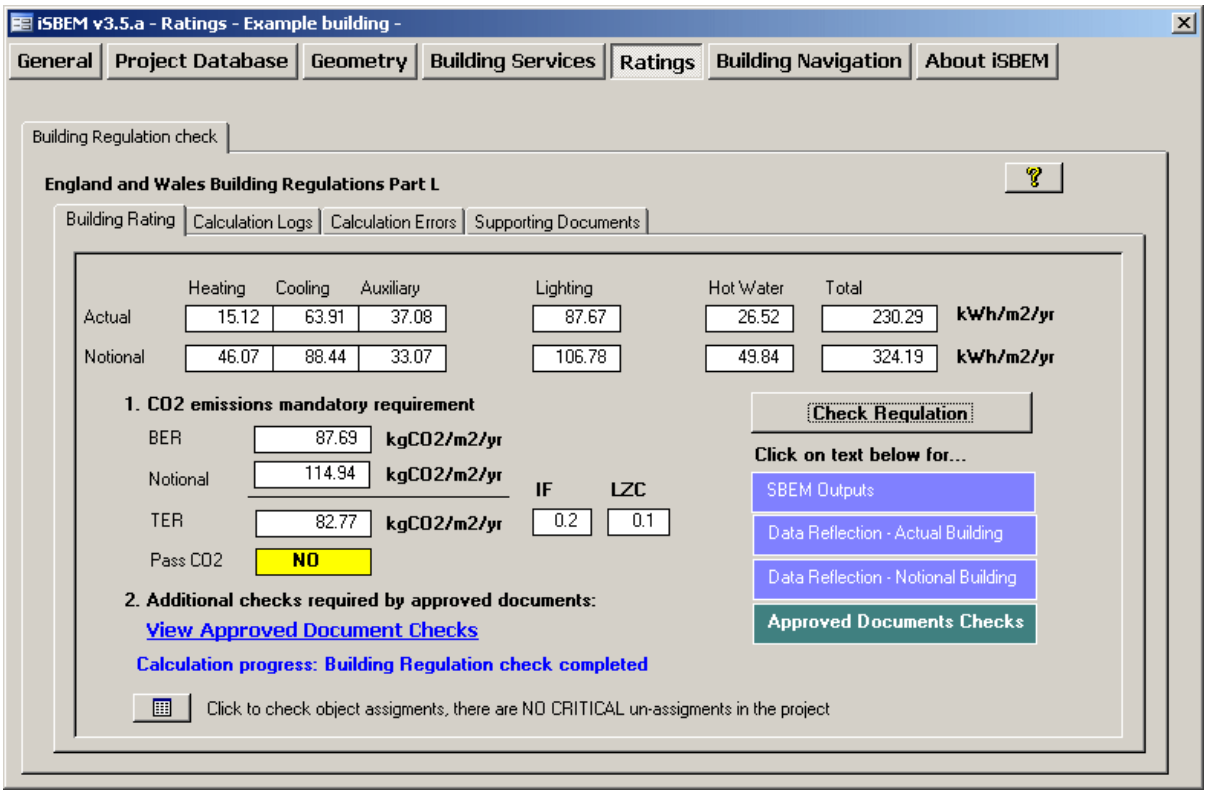


Figure 77: Using the interface to check compliance with Building Regulations in the Building Regulation Check tab of the Ratings form for England and Wales

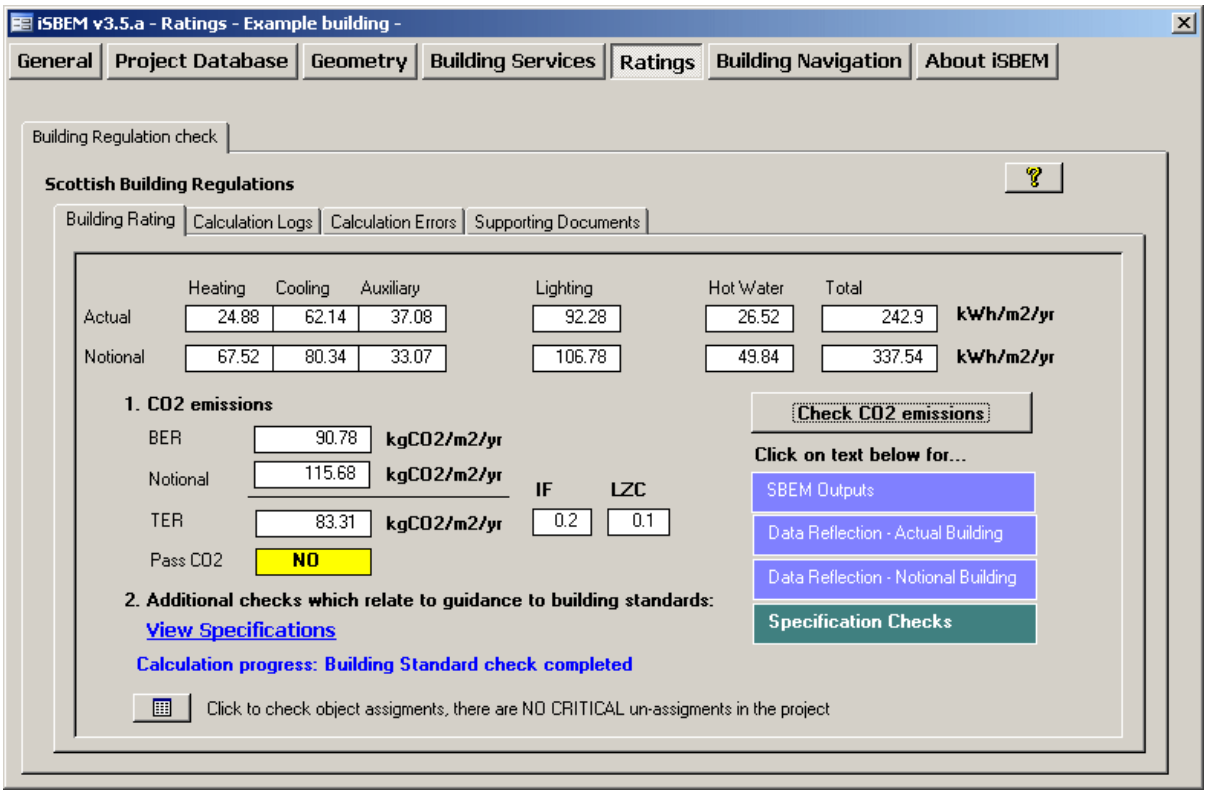


Figure 78: Using the interface to check compliance with Building Regulations in the Building Regulation Check tab of the Ratings form for Scotland

Calculation Logs sub-tab:

Log files for the SBEM calculation (SBEM.log) and the compliance checking module, BRUKL, (BRUKL.log) can be viewed in this sub-tab (Figure 85).

Calculation Errors sub-tab:

Further guidance

Error files for the SBEM calculation (SBEM.err) and the compliance checking module, BRUKL (BRUKL.err) can be viewed in this sub-tab (Figure 86). If the calculation crashes, you can refer to these files for any error messages produced during the calculation.

NEW

Supporting Documents sub-tab:

This sub-tab (Figure 88) contains buttons that allow access to the following supporting (non-official) documents produced by SBEM: the *Main SBEM Output* report (section 8.2.1: SBEM Main Output Document), and the *Data Reflection* Reports (sections 8.2.3: Data Reflection Report – Actual Building, and 8.2.4: Data Reflection Report – Notional Building).

NB: The Data Reflection Reports in html format are generated, and the related access buttons become visible in the *Ratings* form, only if the relevant box is ticked in the *General* form > *File Options* tab > *System Configuration* sub-tab.

NB: You must close all output files before re-running the calculation (so the software can over-write them). Otherwise, an error message will be produced.

8.1.2. Asset Rating tab

This tab is visible only if 'EPC England', 'EPC Wales', 'EPC Scotland', or 'EPC Northern Ireland' were selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab. The *Asset Rating* tab has eight sub-tabs:

- **Building Rating** sub-tab
- **Graphic Rating** sub-tab
- **Recommendations** sub-tab
- **EPC Audit** sub-tab
- **Calculation Logs** sub-tab
- **Calculation Errors** sub-tab
- **Messages** sub-tab

NEW

- **Supporting Documents** sub-tab

Building Rating sub-tab:

The *Asset Rating* is calculated by clicking on the "Calculate EPC Rating" button. This runs the data through the SBEM calculation engine and the Energy Performance Certificate Generator (EPCgen).

NB: Please note that (depending on your Accreditation Scheme Provider) in order to generate the XML message for official lodgement and remove the watermark from the EPC and the Recommendations Report, or in order to generate the IAS file required by your Accreditation Scheme Provider, your computer **must** be connected to the internet, and you may (depending on your Accreditation Scheme Provider) need to enter your "Energy Assessor EPCgen.net Activation Code" into the *General* form > *General Information* tab > *Energy Assessor Details* sub-tab > *Energy Assessor Details* sub-form (see Section 7.3.2: General Information tab). If

there is no internet connection and/or the Activation Code has not been entered, then the XML message will not be generated, the output files produced will contain the watermark, and the IAS file will not be generated. However, this does not apply if 'EPC Scotland' has been selected as the "Purpose of Analysis".

Further guidance

NB: See APPENDIX E: Activation codes and connection to EPCgen.net, for more guidance.

The *Building Rating* sub-tab then displays the following calculated results:

1. The energy used per square metre (kWh/m^2) annually by the actual, notional, and reference buildings for heating, cooling, auxiliary energy (pumps, fans, and controls), lighting, and hot water.
2. The total energy used per square metre (kWh/m^2) annually by the actual, notional, and reference buildings in terms of electricity and fuel use.
3. The resulting annual CO_2 emissions ($kgCO_2/m^2$) from the actual building (BER), the target (Part L TER), the typical building (Stock average TYP), and the standard emission rate (SER). For details on the definition of the reference and typical buildings, SER, and Part L target, see Section 2.3: Calculation basics for UK Energy Performance Certificate purposes.
4. The EPC bands corresponding to the annual CO_2 emissions from the actual building, the SER, the target (Part L TER), and the typical building (Stock average TYP).
5. The *EPC Rating* (*Asset Rating*) of the actual building.

Also accessible from this sub-tab is the *Energy Performance Certificate*, the *Recommendations Report*, the *SBEM Main Output* report, the *Data Reflection* Report for the actual building and supporting recommendations in the form of a secondary not-for-official-submission report (only available for the generation of EPCs for England, Wales and Northern Ireland). See Sections: 8.2.1: SBEM Main Output Document, 8.2.3: Data Reflection Report – Actual Building, 8.2.7: Energy Performance Certificate, 8.2.8: Recommendations Report, and 8.2.11: SBEM Secondary Recommendations Report.

NB: The Data Reflection Reports in html format are generated, and the related access buttons become visible in the *Ratings* form, only if the relevant box is ticked in the *General* form > *File Options* tab > *System Configuration* sub-tab.

NB: If any changes are made to a project (i.e., input parameters), the "Calculate EPC Rating" button needs to be clicked on again upon returning to this tab in order to update the results as the results figures are not refreshed automatically.

NB: You must close all output files before re-running the calculation (so the software can over-write them). Otherwise, an error message will be produced.

Figure 79 shows the *Building Rating* sub-tab in the *Asset Rating* tab of the *Ratings* form for England and Wales and Figure 80 shows the same for Scotland. The message at the bottom of the screen indicates that there are no critical un-assignments in the project. If there were, the user would need to click on the "Objects Report" button, identify the un-assignment, make the correction in the appropriate part of iSBEM, then return to this page, and then click the "Calculate EPC Rating" button.

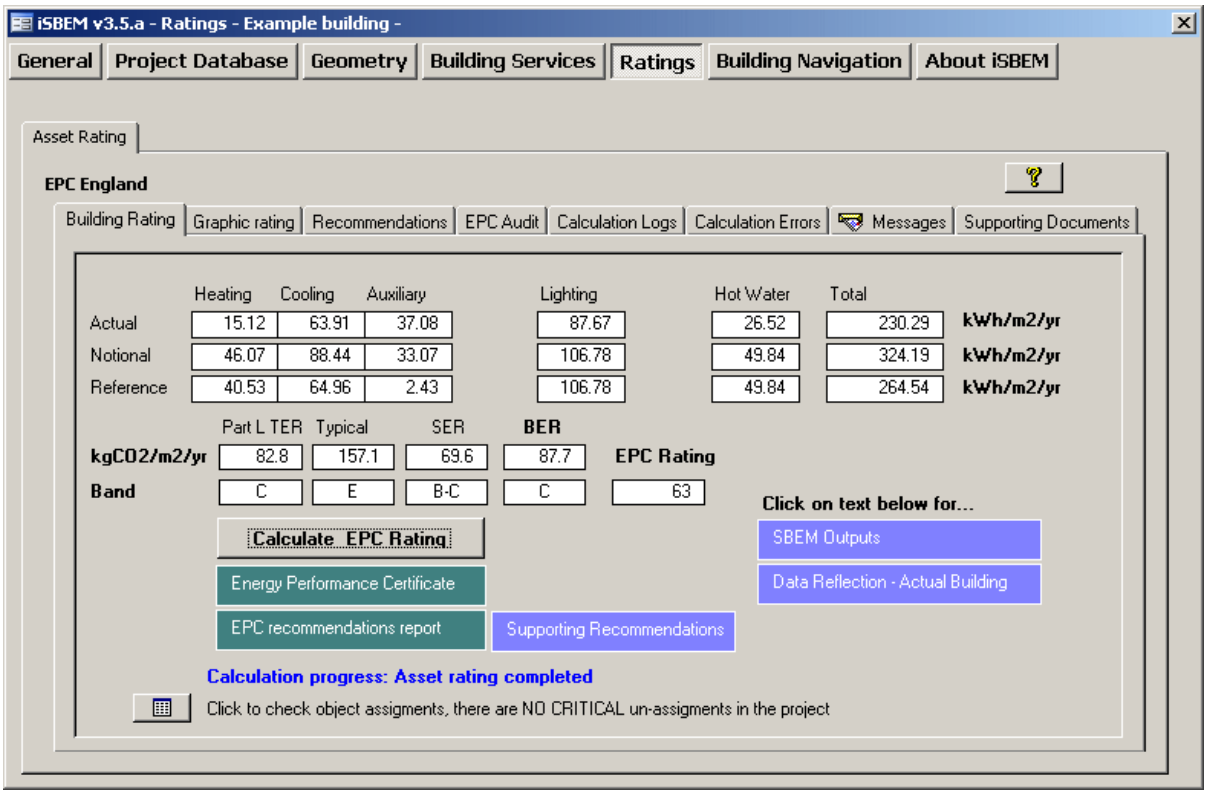


Figure 79: Using the interface to calculate the Asset Rating for the building in the Asset Rating tab of the Ratings form for England and Wales

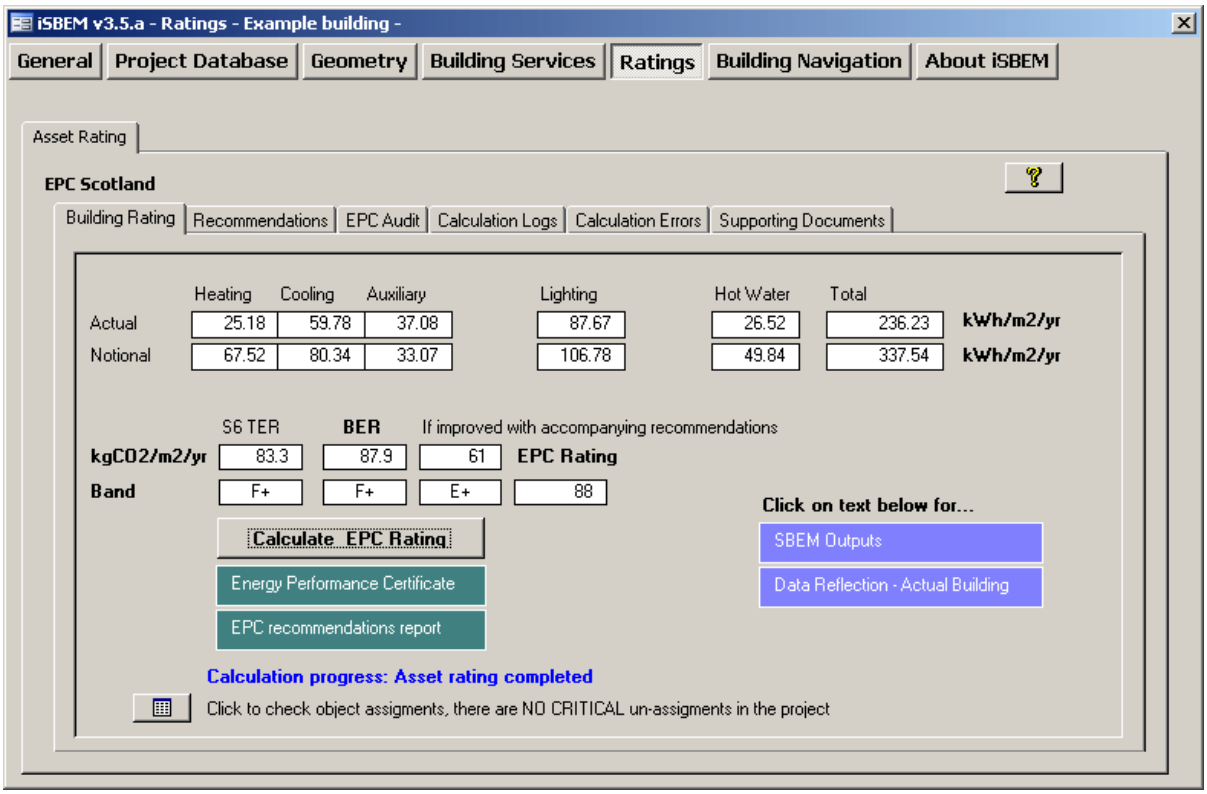


Figure 80: Using the interface to calculate the Asset Rating for the building in the Asset Rating tab of the Ratings form for Scotland

Graphic Rating sub-tab:

The *Graphic Rating* sub-tab (Figure 81) is only visible for the generation of EPCs for England, Wales and Northern Ireland. It displays the following:

1. A graph of the EPC rating band scale showing the energy bands and asset ratings corresponding to the annual CO_2 emissions from the actual building, the target (Part L TER), the typical building (Stock average TYP), and the reference and zero CO_2 emissions benchmarks.

The same graph is also displayed in the Energy Performance Certificate.

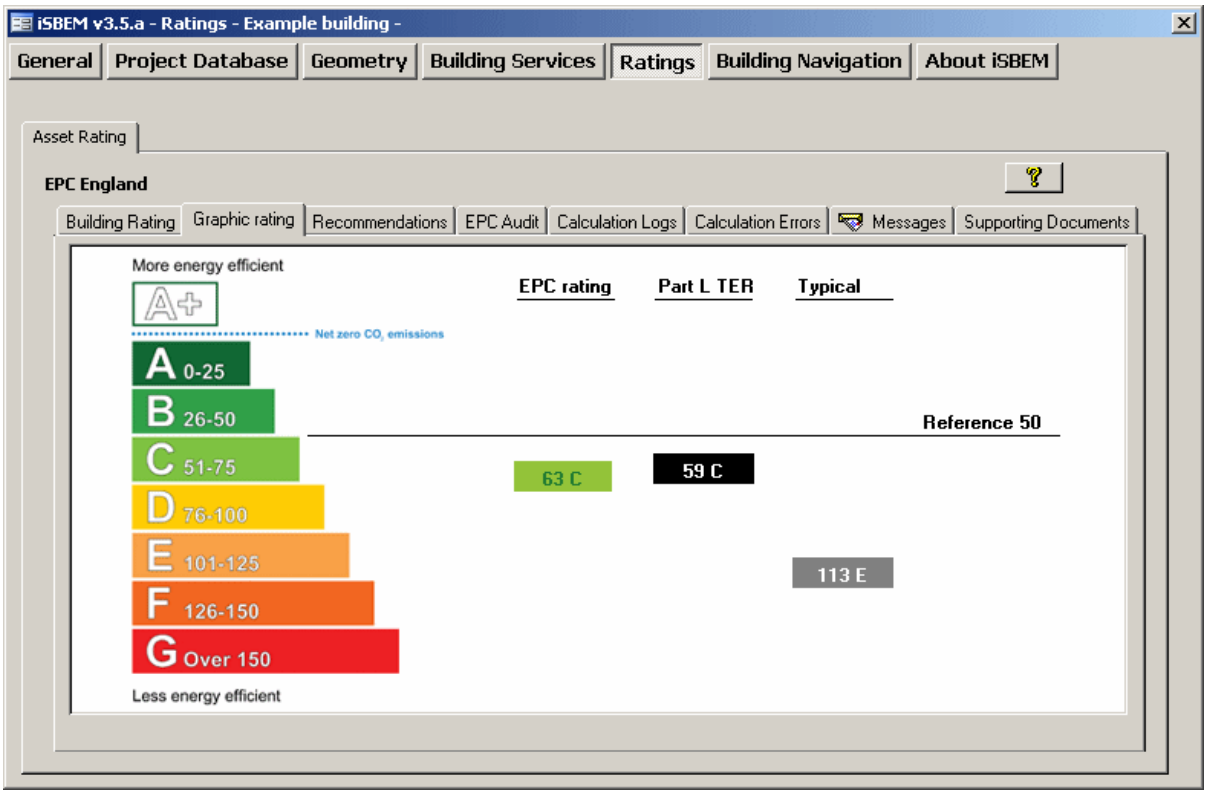


Figure 81: The Graphic Rating sub-tab in the Asset Rating tab of the Ratings form

Task 19: Check compliance with Building Regulations and calculate the Asset Rating

If you ensure that the "Purpose of Analysis" parameter is set to 'England and Wales Building Regulations Part L', in the *General* form > *General Information* tab > *Project Details* sub-tab, and click into the *Ratings* form, you should find yourself in the *Building Rating* sub-tab of the *Check Building Regulations* tab. Check that the message at the bottom of the screen says that there are no critical un-assignments in this project, and then click on the "Check Regulation" button. Once the calculation is completed, you will be able to view the *Building Regulations Compliance* document and *Main SBEM Output* Report (which you can compare to the versions included in APPENDIX A:). Then, go to the *General* form > *General Information* tab > *Project Details* sub-tab and change the "Purpose of Analysis" parameter to 'EPC England'. Finally, go back to the *Ratings* form > *Asset Rating* tab > *Building Rating* sub-tab and click on the "Calculate EPC Rating" button. Once the calculation is complete, you will be able to view the *Energy Performance Certificate* and the *EPC Recommendations Report* (APPENDIX A: includes samples of the EPC and the Recommendations report).

You have now completed this tutorial.

Recommendations sub-tab:

Once the *Asset Rating* has been calculated successfully, the EPCgen module produces the *EPC* and the *Recommendations* Report. The latter contains the NCM and user-defined recommendations for energy efficiency improvements to the actual building. This sub-tab is visible only if EPC generation has been selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab. This sub-tab (Figure 82) contains the following parameters:

1. There are 4 radio buttons in a box entitled "Show recommendations":
    a. All NCM – Click this button to view only the NCM recommendations generated by EPCgen.
    b. All USER – click this button to view only the recommendations added by the user. If there are no user-defined recommendations, then iSBEM will prompt you to add one (see below).
    c. All – Click this button to view both the NCM recommendations and the ones added by the user.
    d. Only from Report – Click this button to view only the recommendations that have been included in the *Recommendations* report.

In addition to creating new recommendations in this sub-tab, the energy assessor can also edit the NCM recommendations generated by EPCgen by adding comments and/or modifying the calculated impacts, using the following parameters:

2. Click to edit this recommendation – By ticking this tick-box, you indicate that you wish to edit this particular NCM recommendation (whose text can be viewed in the grey box entitled "Recommendation") generated by EPCgen. If the box is ticked, the following fields become active:

a. Assessor Comments - You can enter any comments related to the recommendation, for e.g., the reason why you have chosen to edit this NCM recommendation. These comments will appear in SBEM's supporting documents to the *Recommendations* report.

b. Energy Impact - You can select from the options available in the drop-down menu in order to specify the potential impact of implementing the recommendation on the energy performance of the actual building. (HIGH = change in total building energy is >4%, MEDIUM = change in total building energy is =<4% and >0.5%, LOW = change in total building energy is <0.5%).

c. CO_2 Impact - You can select from the options available in the drop-down menu in order to specify the potential impact of implementing the recommendation on the CO_2 emissions of the actual building. (HIGH = change in total building CO_2 emissions is >4%, MEDIUM = change in total building CO_2 emissions is <=4% and >0.5%, LOW = change in total building CO_2 emissions is <0.5%). This impact will appear in the *Recommendations* report.

d. CO_2 Saved per £ Spent - You can select from the options available in the drop-down menu (GOOD, FAIR, POOR, and UNKNOWN) in order to specify the potential CO_2 emissions saved from the actual building per pound spent on implementing the recommendation in the actual building.

e. Payback (drop-down menu) - You can select from the options available in the drop-down menu (LONG, MEDIUM, SHORT, and UNKNOWN) in order to specify the typical payback time for implementing the recommendation in the actual building. (LONG = payback is >7 years, MEDIUM = payback is >=3 years and <7 years, SHORT = payback is <3 years). If you know the exact figure for payback time in years, use the next parameter instead.

f. Payback (number) – Here you can input, in years, the typical payback time for implementing the recommendation in the actual building. If you do not know the exact figure for payback time in years, use the previous parameter instead.

The following fields, however, remain greyed-out or un-editable as the user is not allowed to modify these parameters of NCM recommendations:

a. Category – This describes the category under which the recommendation is classified, such as heating, cooling, etc.

b. Code – This describes a unique code for each NCM recommendation. The code of any recommendation created by the energy assessor will be USER.

c. Recommendation – This describes the text of the NCM recommendation. This text will appear in the *Recommendations* report.

d. Applicable to – This describes the object to which the recommendation applies, for e.g., the whole building or a particular HVAC system or HWS.

3. Click to take out – By ticking this tick-box, you indicate that you wish to remove this particular NCM recommendation, which was generated by EPCgen, from the *Recommendations* Report.

If the "All USER" radio button is selected in the "Show recommendations" box or the "Add new record" button at the bottom of the screen is clicked, then iSBEM will prompt you to create a new recommendation.

4. Once you have confirmed that you do wish to add a recommendation to the ones already generated by EPCgen, then the following fields become active (Figure 83):

a. Category - You can select from the options available in the drop-down menu in order to specify the category under which the recommendation will be classified.

b. Code – This parameter should remain set to 'USER' for any user-defined recommendation.

c. Recommendation – You can enter text to describe the newly-added recommendation. This text will appear in the *Recommendations* report.

d. Assessor Comments - You can enter any comments related to the recommendation, for e.g., the reason why you have chosen to edit this NCM recommendation. These comments will appear in SBEM's supporting documents to the *EPC Recommendations* report.

g. Energy Impact - You can select from the options available in the drop-down menu in order to specify the potential impact of implementing the recommendation on the energy performance of the actual building. (HIGH = change in total building energy is >4%, MEDIUM = change in total building energy is =<4% and >0.5%, LOW = change in total building energy is <0.5%). **NB:** If you enter the value as UNKNOWN, SBEM will set it to LOW.

h. CO_2 Impact - You can select from the options available in the drop-down menu in order to specify the potential impact of implementing the recommendation on the CO_2 emissions of the actual building. (HIGH = change in total building CO_2 emissions is >4%, MEDIUM = change in total building CO_2 emissions is <=4% and >0.5%, LOW = change in total building CO_2 emissions is <0.5%). This impact will appear in the *Recommendations* report. **NB:** If you enter the value as UNKNOWN, SBEM will set it to LOW.

i. CO_2 Saved per £ Spent - You can select from the options available in the drop-down menu (GOOD, FAIR, POOR, and UNKNOWN) in order to specify the potential CO_2 emissions saved from the actual building per pound spent on implementing the recommendation in the actual building. **NB:** If you enter the value as UNKNOWN, SBEM will set it to POOR.

j. Payback (drop-down menu) - You can select from the options available in the drop-down menu (LONG, MEDIUM, SHORT, and UNKNOWN) in order to specify the typical payback time for implementing the recommendation in the actual building. (LONG = payback is >7 years, MEDIUM = payback is >=3 years and <7 years, SHORT = payback is <3 years). **NB:** If you enter the value as UNKNOWN, SBEM will set it to LONG. <u>If you know the exact figure for payback time in years, use the next parameter instead.</u>

e. Payback (number) – Here you can input, in years, the typical payback time for implementing the recommendation in the actual building. <u>If you do not know the exact figure for payback time in years, use the previous parameter instead.</u>

f. Applicable to – Here you can specify the object to which the recommendation applies, for e.g., the whole building or a particular HVAC system or HWS. If the option selected is either 'HVAC-SYSTEM' or 'HWS', then the following parameter becomes active:

   i. Name – You need to specify the name of the particular HVAC system or HWS (already defined in iSBEM) to which the user-defined recommendation refers.

NB: Only recommendations that are defined as applicable to the whole building, i.e., the parameter "Applicable to" has been set to 'BUILDING', appear in the official Recommendations report. All the defined recommendations, however, will appear in SBEM's Secondary Recommendations report.

5. Delete Recommendation – This button allows you to delete a user-defined recommendation.

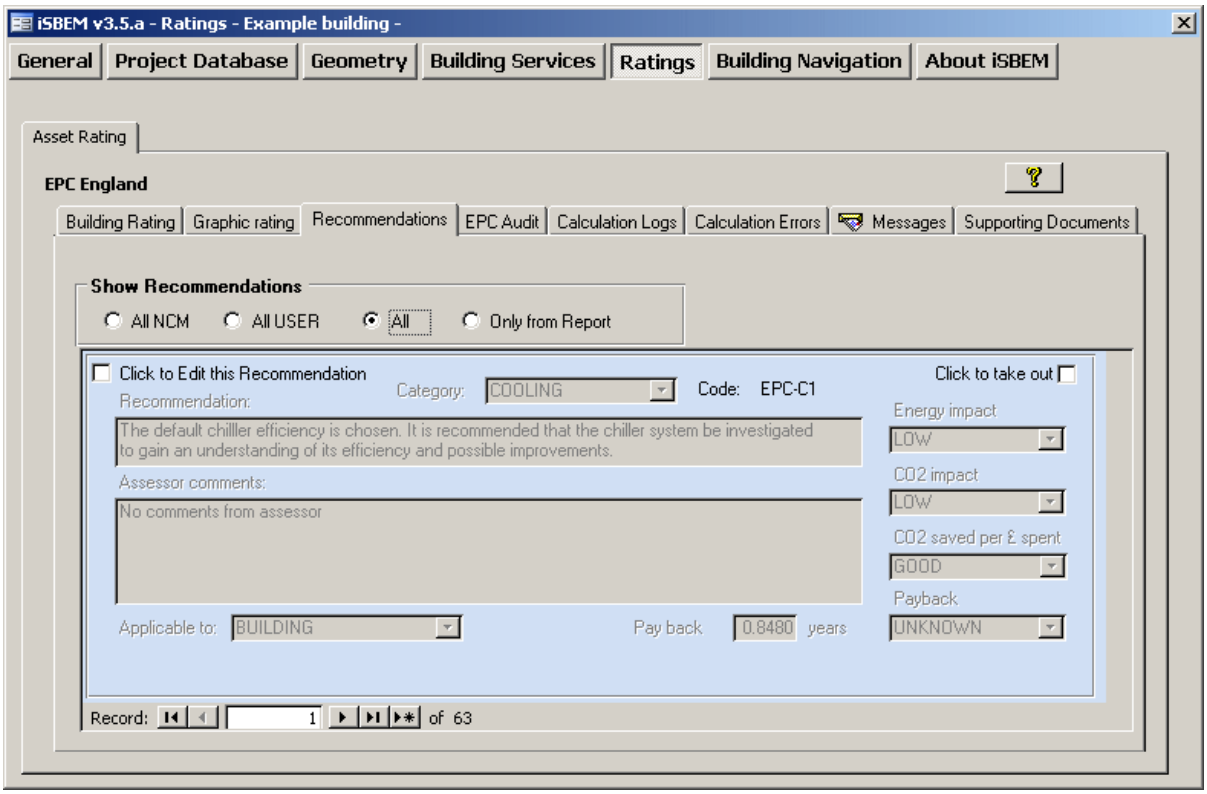


Figure 82: The Recommendations sub-tab in the Asset Rating tab of the Ratings form showing an NCM recommendation

NB: After editing, deleting, or adding any recommendations, you need to re-run the calculation in order to re-generate the Recommendations Report with all your editing applied.

NB: The NCM recommendations are generated for the building and its energy systems when operated according to standard schedules appropriate to the general activities in the building. The Energy Assessor is expected to use his or her knowledge to remove inappropriate ones and possibly to add additional ones. If the Energy Performance Rating calculation has made extensive use of default values, some of the recommendations may be based on uncertain assumptions. These recommendations do not cover the quality of operation or maintenance of the building and its systems. There are frequently significant opportunities for energy and carbon savings in these areas and a full "energy audit" to identify them is strongly recommended.

NB: Once a recommendation has been edited by the user, it can no longer be displayed in the Recommendations Report as being automatically generated by the calculation, and so cannot appear in any of the first 3 tables. It must appear in the fourth table containing the users' added or edited recommendations. This is the case if the 'tick to edit' box is ticked for a recommendation (even if no changes are actually made or comments are added by the user after ticking the box).

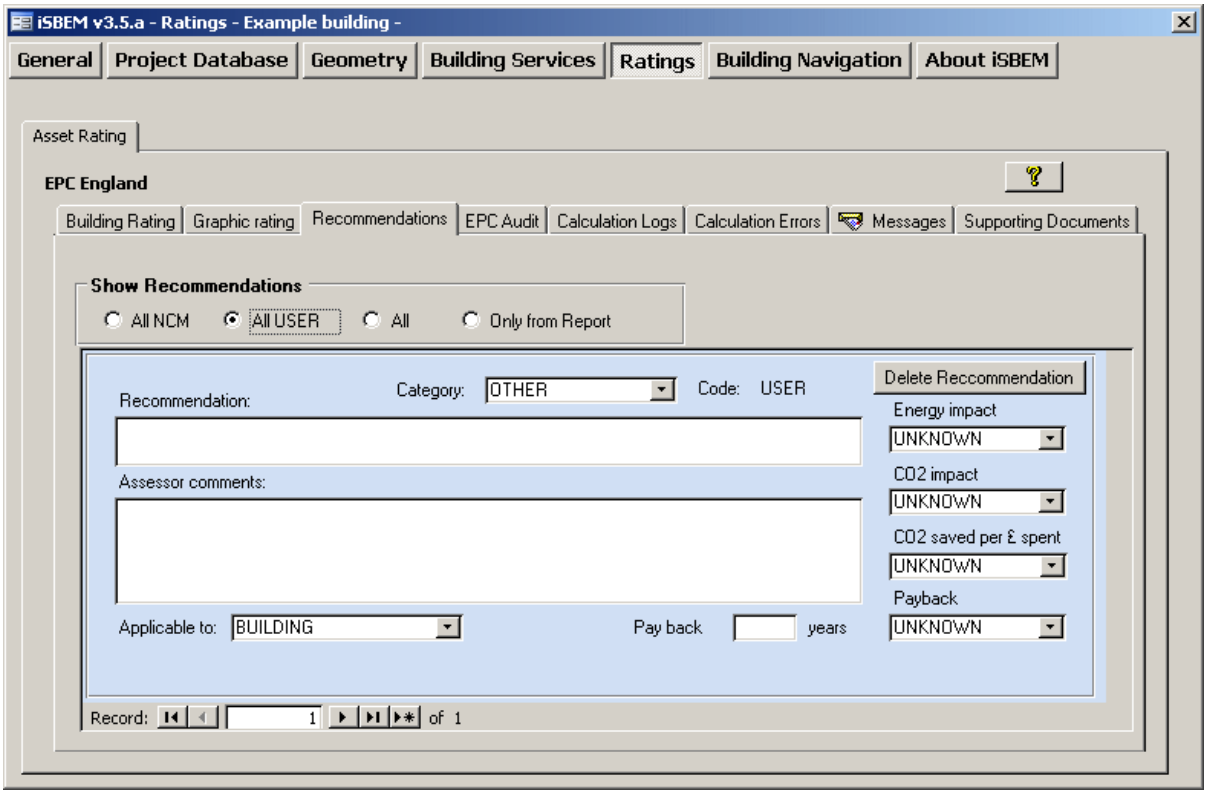


Figure 83: The Recommendations sub-tab in the Asset Rating tab of the Ratings form showing the active fields for creating a user-defined recommendation

EPC Audit sub-tab:

This sub-tab is visible only if EPC generation has been selected as the “Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab. The *EPC Audit* sub-tab (Figure 84) contains four sub-forms as follows:

- **Construction** sub-form – contains the audit trail information relating to the construction input parameters, i.e., construction specification of walls, floors, roofs, windows, rooflights, and doors.
- **Geometry** sub-form - contains the audit trail information relating to the geometry input parameters, i.e., definitions of thermal bridges; air permeability; and shading systems on glazing.
- **HVAC & HWS** sub-form - contains the audit trail information relating to the HVAC and HWS input parameters, i.e., heating and cooling system type; heating and cooling efficiencies, duct and AHU leakage, specific fan power, HWS generator efficiency, metering and controls provision, and high pressure drop air filtration.
- **Lighting** sub-form - contains the audit trail information relating to the lighting input parameters, i.e., lamp type, lighting controls, and parasitic power.

This sub-tab is where the energy assessor provides supporting evidence for over-riding any of the default values in iSBEM. This information is necessary for the audit trail regarding all the

parameters that are used to carry out the energy calculations for the generation of the EPC, should any of the default values or settings be changed by the energy assessor. Each of the above four sub-sub-tabs contains the following:

1. Accept defaults – this is the list of defaults set in iSBEM for each of: Construction, Geometry, HVAC & HWS, and Lighting, which the energy assessor can over-ride.
2. Assessor walk-though inspection – supporting evidence based on a walk-through inspection by the energy assessor.
3. Inspection by other: Sales particulars - supporting evidence based on sales particulars.
4. Inspection by other: Technical inspection - supporting evidence based on a technical inspection by someone other than the energy assessor.
5. On-site measurements of input parameters for assessment - supporting evidence based on on-site measurements of the input parameters.
6. Other sources - supporting evidence based on other sources.
7. Comments – additional information that the energy assessor would like to include for the audit trail.

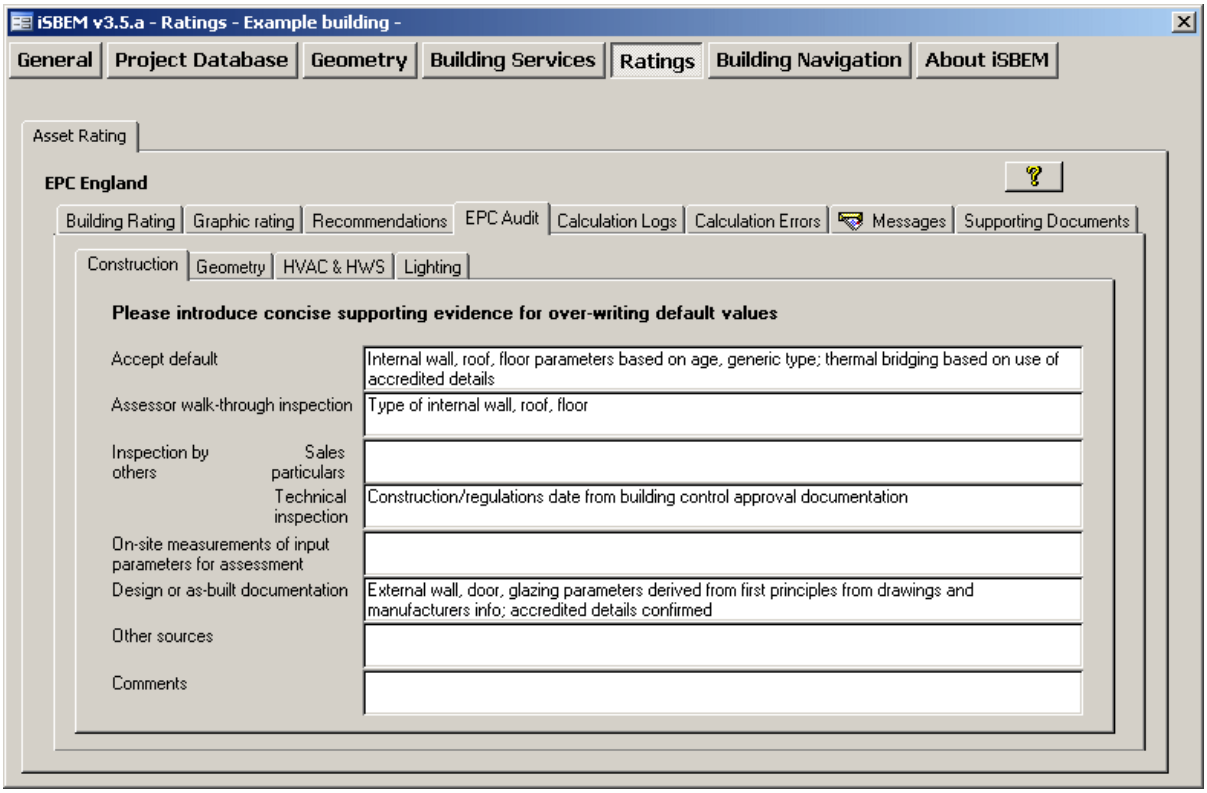


Figure 84: The EPC Audit sub-tab in the Asset Rating tab of the Ratings form

Calculation Logs sub-tab:

Log files for the SBEM calculation (SBEM.log), the compliance checking module, BRUKL, (BRUKL.log), and the EPC generator, EPCgen, (EPCgen.log) can be viewed in this sub-tab (Figure 85).

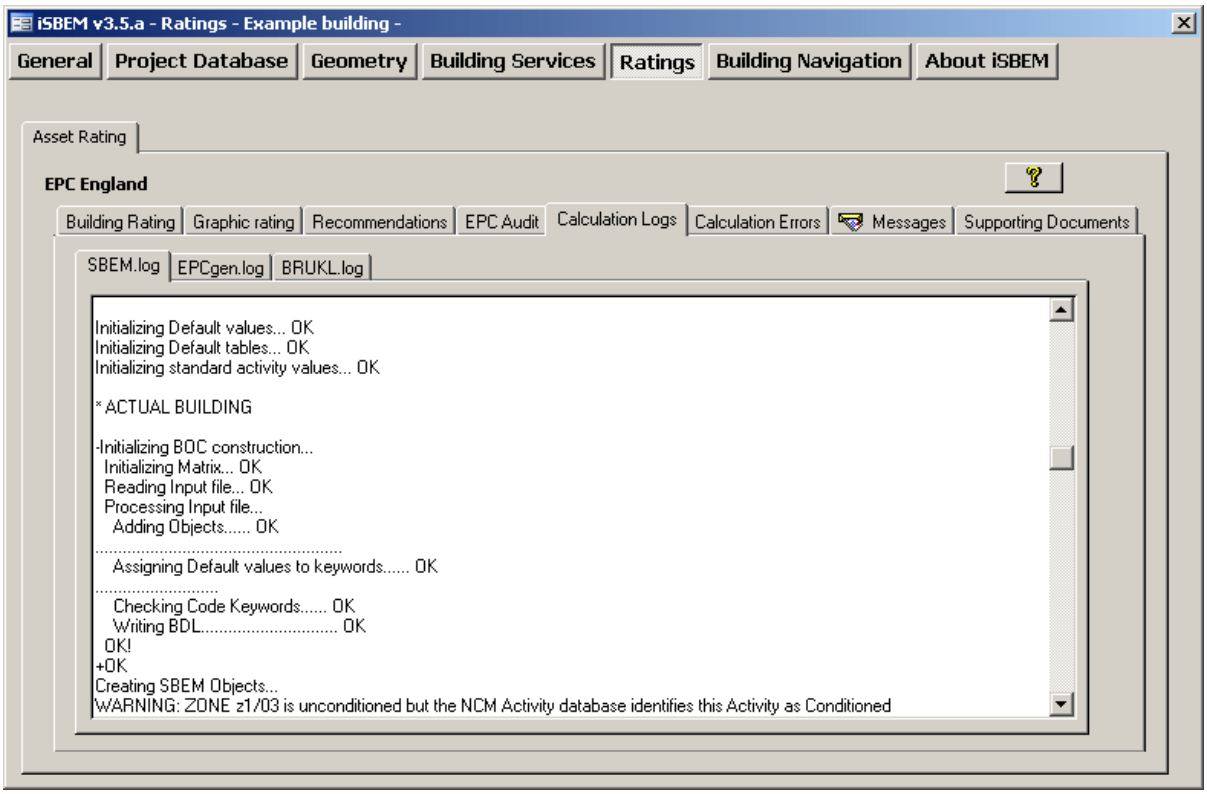


Figure 85: The Calculation Logs sub-tab in the Asset Rating tab of the Ratings form

Calculation Errors sub-tab:

Further guidance

Error files for the SBEM calculation (SBEM.err), the compliance checking module, BRUKL, (BRUKL.err), and the EPC generator, EPCgen, (EPCgen.err) can be viewed in this sub-tab (Figure 86). If the calculation crashes, you can refer to these files for any error messages produced during the calculation.

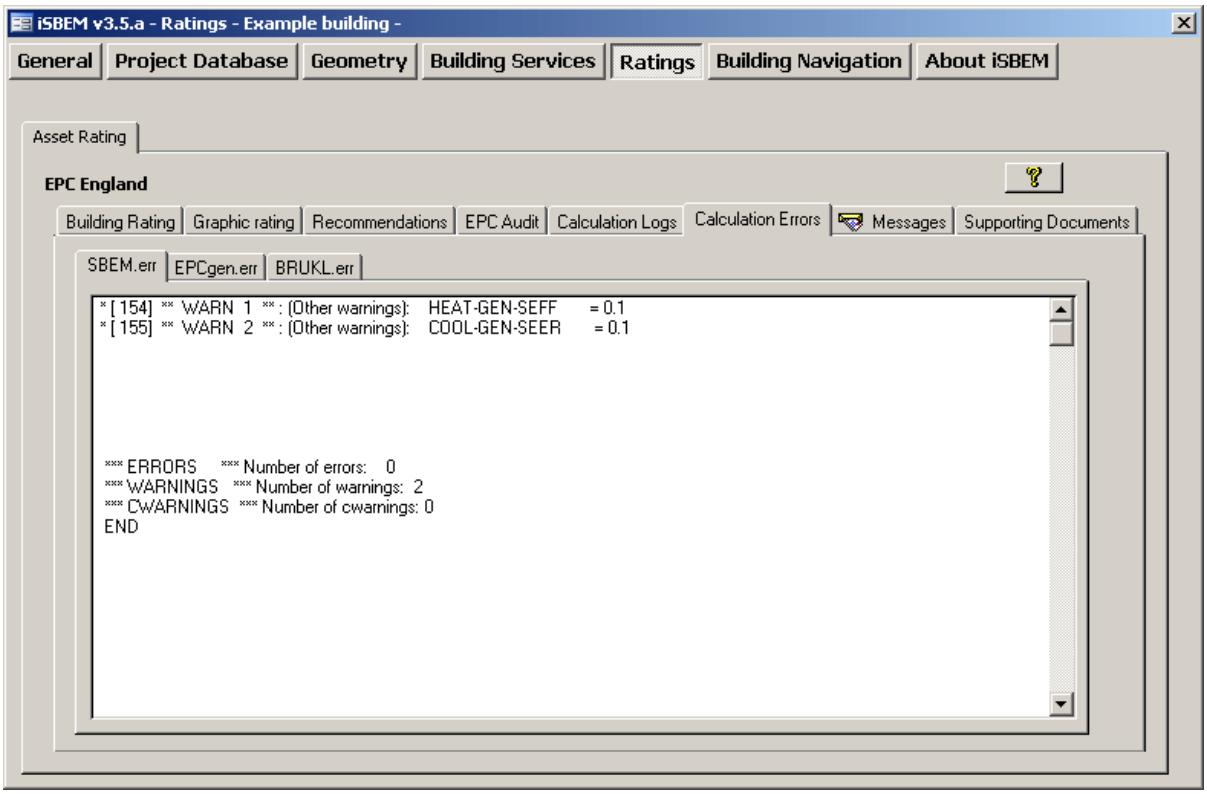


Figure 86: The Calculation Errors sub-tab in the Asset Rating tab of the Ratings form

Messages sub-tab:

You may receive messages (critical or non-critical), e.g., from EPCgen.Net, after running calculations for generating EPCs, and they can be viewed in this sub-tab (Figure 87).

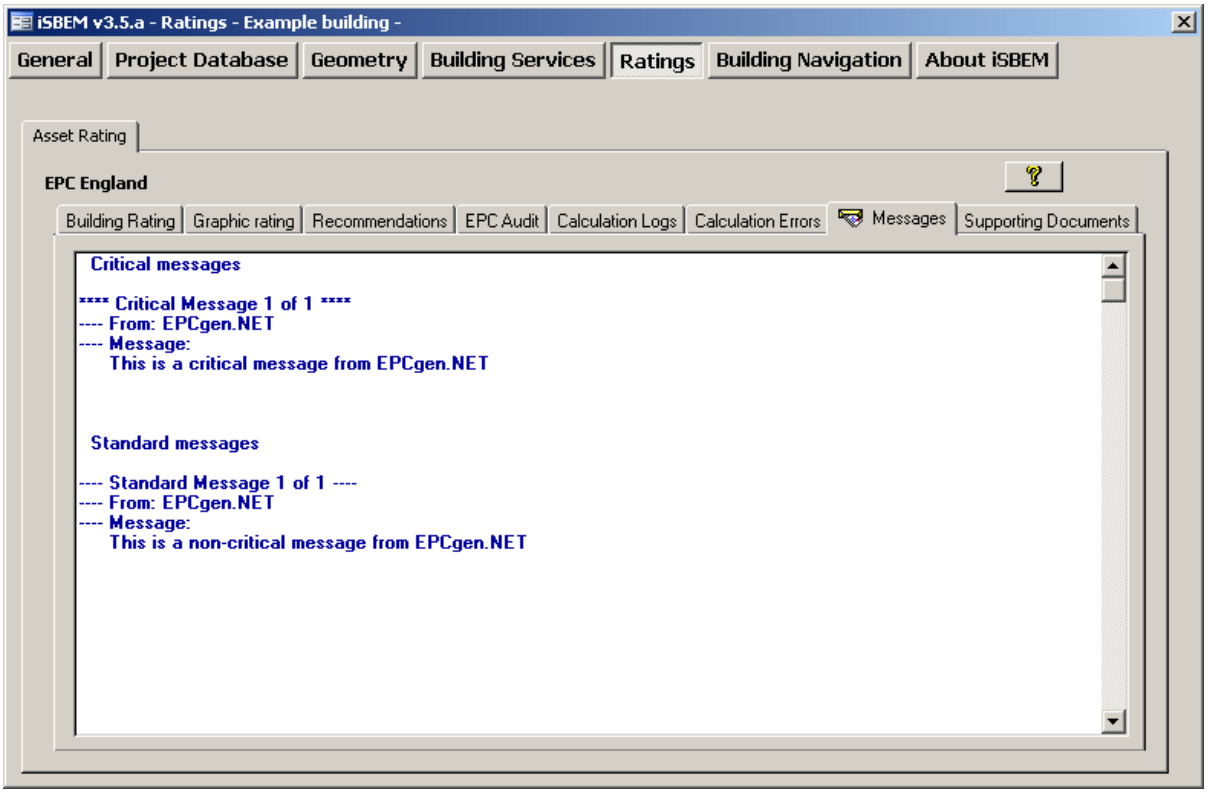


Figure 87: The Messages sub-tab in the Asset Rating tab of the Ratings form

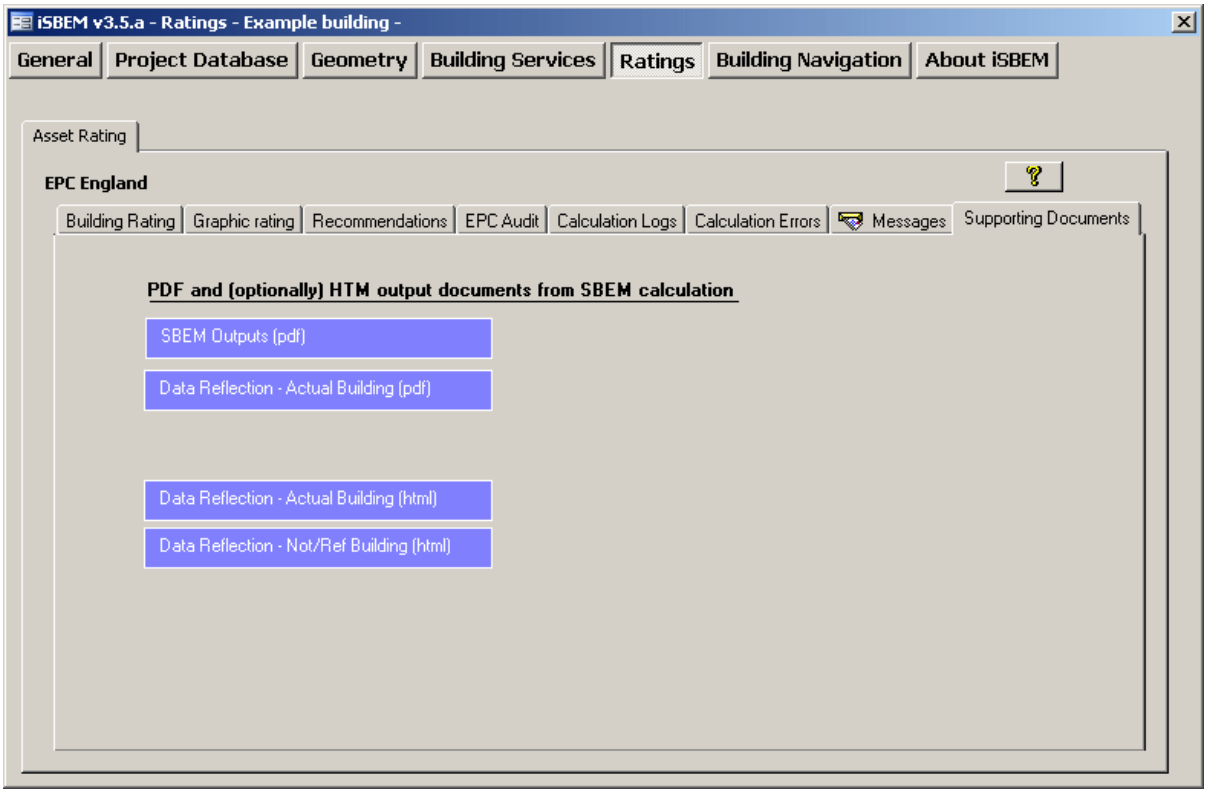
NEW

Supporting Documents sub-tab:

This sub-tab (Figure 88) contains buttons that allow access to the following supporting (non-official) documents produced by SBEM: the *Main SBEM Output* report (section 8.2.1: SBEM Main Output Document), and the *Data Reflection* Reports (sections 8.2.3: Data Reflection Report – Actual Building, and 8.2.4: Data Reflection Report – Notional Building).

NB: The Data Reflection Reports in html format are generated, and the related access buttons become visible in the *Ratings* form, only if the relevant box is ticked in the *General* form > *File Options* tab > *System Configuration* sub-tab.

NB: You must close all output files before re-running the calculation (so the software can over-write them). Otherwise, an error message will be produced.



NEW **Figure 88: The Supporting Documents sub-tab in the Asset Rating tab of the Ratings form**

8.2. SBEM Output reports

Output reports when running SBEM for building regulations compliance checking:

If either 'England and Wales Building Regulations Part L', 'Scottish Building Regulations', or 'Northern Ireland Building Regulations Part F' were selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab, and the calculation was run to check compliance with building regulations, then SBEM produces **six** output reports. The six reports produced by SBEM are as follows, the first four of which can be accessed from the *Ratings* form > *Asset Rating* tab > *Building Rating* sub-tab (see Figure 77):

1. SBEM Main Calculation Output Document
2. SBEM BRUKL Output Document: Compliance with Building Regulations ('Specification Information' for Scottish Building Regulations)
3. Data Reflection Report – for the Actual Building

4. Data Reflection Report – for the Notional Building
5. Technical Output Report – for the Actual Building
6. Technical Output Report – for the Notional Building

As described in the previous section, the first four reports are accessible from within iSBEM, using the appropriate buttons or hyperlinks in the *Ratings* form > *Building Regulations Check* tab > *Building Rating* sub-tab. These reports are all stored in the same location as the project files, along with the *Technical Output* Reports, which can only be accessed from the Projects folder. The default location for the project files is within the specific project folder (created when the project was first created, see Section 4.4: Creating new and opening existing projects) within the iSBEM_v3.5.a folder, e.g., C:\NCM\\iSBEM_v3.5.a\ Projects\Example building-complete.

Output reports when running SBEM for Energy Performance Certificates:

If either 'EPC England', 'EPC Wales', 'EPC Scotland', or 'EPC Northern Ireland' were selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab, and the calculation was run to generate the Energy Performance Certificate, then SBEM produces **nine** output reports. The nine reports produced by SBEM are as follows.

1. SBEM Main Output Document
2. Energy Performance Certificate
3. Recommendations Report
4. Data Reflection Report – for the Actual Building
5. Technical Output Report – for the Actual Building
6. Technical Output Report – for the Notional Building
7. Technical Output Report – for the Reference Building
8. Technical Output Report – for the Typical Building

The following additional report is also produced but only during the generation of the Energy Performance Certificate for England, Wales, and Northern Ireland.

9. SBEM Secondary Recommendations Report

As described previously, the first four reports are accessible from within iSBEM, using the appropriate buttons or hyperlinks in the *Ratings* form > *Asset Rating* tab > *Building Rating* sub-tab. These reports are all stored in the same location as the project files, along with the *Technical Output* Reports, which can only be accessed from the Projects folder. The default location for the project files is within the specific project folder (created when the project was first created, see Section 4.4: Creating new and opening existing projects) within the iSBEM_v3.5.a folder, e.g., C:\NCM\\iSBEM_v3.5.a\ Projects\Example building-complete.

For assessors accredited by an Accreditation Scheme Provider that allows Energy Assessors to generate the final EPC documents for lodgement through the Energy Assessors' computers, one more file is produced when running the asset rating calculation and generating the EPC for England, Wales, and Northern Ireland. This file is the XML message required for the official submission/lodgement of the EPC with the National Register. It contains all the data used in the generation of the Energy Performance Certificate and the EPC Recommendations report. Please note that in order to generate the XML message for official lodgement and remove the watermark from the EPC and the Recommendations Report, your computer **must** be connected to the internet, and you need to have entered your "Energy Assessor EPCgen.net Activation Code" into the *General* form > *General Information* tab > *Energy Assessor Details* sub-tab > *Energy Assessor Details* sub-form (see Section 7.3.2: General Information tab). However, this does not apply if 'EPC Scotland' has been selected as the "Purpose of Analysis".

If, however, your Accreditation Scheme Provider generates the final EPC documents for lodgement in a central system for the Accreditation Scheme, the XML file will not be generated

on your computer, and instead an IAS file will be produced, which is a file required by your Accreditation Scheme Provider. Please note that in order to generate the IAS file required by the Accreditation Scheme Provider, your computer **must** be connected to the internet. If there is no internet connection, then the IAS file will not be generated. The output files produced on your computer will always contain the watermark (see Section 7.3.2: General Information tab).

Further guidance

NB: See APPENDIX E: Activation codes and connection to EPCgen.net, for more guidance.

8.2.1. SBEM Main Output Document

This report can be accessed from the *Ratings* form > *Building Regulations Check* tab > *Building Rating* sub-tab when checking compliance with building regulations and the *Ratings* form > *Asset Rating* tab > *Building Rating* sub-tab when generating an EPC, by clicking on the "SBEM output" button, and it is stored in the same location as the project files as described in Section 8.2.12: Accessing the reports from the project folder. The file is in "pdf" format.

This report gives a summary of the energy consumptions and CO_2 emissions of the building. It provides:

- The name and type of the building.
- A bar chart showing the annual CO_2 emissions from the building, in kg/m^2, due to fuel and electricity consumptions. It also shows the amount of annual CO_2 emissions displaced by renewables, if applicable, and the building area, in m^2.
- A bar chart showing the annual energy consumption of the building for the different end uses, in kWh/m^2.
- A bar chart showing the variation of the monthly energy consumption by the different end uses along the year, in kWh/m^2.
- A pie chart displaying the percentage of the total annual energy consumption that is due to each of the end uses, with the energy consumed by equipment excluded from the total.
- A pie chart displaying the percentage of the total annual energy consumption that is due to each of the end uses, with the energy consumed by equipment included in the total.

See APPENDIX A:, A.5 for the *SBEM Main Output* Document for the Example building.

NB: You must close all output files before re-running the calculation (so the software can over-write them). Otherwise, an error message will be produced.

8.2.2. SBEM BRUKL Output Document: Compliance with Building Regulations

This report can be accessed from the *Ratings* form > *Building Regulations Check* tab > *Building Rating* sub-tab by clicking on the "Approved Documents checks" button or hyperlink, and as with the SBEM main output report, it is stored in the same location as the project files, as described in Section 8.2.12: Accessing the reports from the project folder. The file is in "pdf" format.

SBEM's *Building Regulations Compliance* Document ('Specification Information' for Scottish Building Regulations, which has slight differences in format) will form part of the submission by designers to Building Control to demonstrate compliance, for e.g., with the England and Wales Building Regulations Part L. The SBEM *Building Regulations Compliance* Document currently follows, in format, the Compliance Checklist criteria found in England and Wales' Approved Document L2A Appendix A. Where SBEM can be used to demonstrate compliance, SBEM will fill in the appropriate sections of the document. For example:

> Criterion 2, Section 2.1: displays the limiting standards for the building fabric U-values and the values calculated for the different envelope elements in the building, and a warning is shown if any of the building's U-values is worse than the limiting standards.

Criterion 2, Section 2.2: displays the limiting standard for air permeability and the value used in the building, and a warning is shown if the limiting standard is exceeded.

On the other hand, where compliance should be demonstrated in separate supporting documents (i.e., it cannot be performed through SBEM), the SBEM *Compliance Document* will state that clearly. For example:

Criterion 2, Section 2.5: Energy Meters installed in accordance with CIBSE TM39

Separate submission

Criterion 4, Section 4.6: Has commissioning been completed satisfactorily?

Separate submission

This compliance document contains the following sections:

- Administrative Information: This section gives information about the project's address, the building's owner including name, telephone number, and address, and the building's certifier including name, telephone number, and address. It also gives information about the certification tool used to generate the results
- Criterion 1: This section of the report contains information about the building's predicted CO_2 emission rate (BER) and the target CO_2 emission rate (TER) in kg/m^2.year. It then states whether the building's emission rate is less than or equal to the target value.
- Criterion 2: This section of the report contains information about the building fabric, including the construction U-values, air permeability, and the building services systems. Then, the report states whether the building's U-values are better than the design limits for each construction type and whether the air permeability of the building is better than the worse acceptable standard. It also states whether the building service standards are acceptable compared to their limiting standards.

NB: Note that the Building Regulations compliance check regarding U-values will be applied by the tool to all envelopes which are not adjacent to a 'Conditioned adjoining space' or 'Same space'. Also note that the tool will not check the U-values of elements in unconditioned zones for compliance.

NB: According to ADL2A, buildings with less than 500 m^2 total useful floor area may avoid the need for a pressure test provided that the air permeability is taken as 15 m^3/(h.m^2) at 50 Pa. SBEM is able to acknowledge this during the compliance checking.

NB: The area-weighted average U-value displayed in the BRUKL document is calculated using the U-values of the different envelope elements and their areas as follows:

$$U_{avg} = \frac{\sum (A_i \times U_i)}{\sum A_i}$$

where U_{avg} = area-weighted average U-value, A_i = area of envelope i, and U_i = U-value of material of envelope i.

NB: The overheating calculation implemented in SBEM version 3.0.b was originally developed to provide guidance for recommendations accompanying EPCs, and discussions are currently taking place regarding possible refinements of the calculation for building regulations compliance checking purposes. Hence, a modified version of this calculation might be available in the future. In the meantime, you will need to continue carrying out the overheating compliance check separately outside SBEM as you have been doing with versions prior to 3.0.b.

- Criterion 4: This section of the report states whether the performance of the building as built is consistent with the BER. Compliance is not checked by the tool for this criterion. (This is not included for Scottish Building Regulations.)

- Criterion 5: This section covers the provision of information about the building. Compliance is not checked by the tool for this criterion. (This is not included for Scottish Building Regulations.)
- Technical Data Sheet (Actual Vs. Notional Building): This section displays some information about the overall energy performance of the building (actual and notional) and some specific information on the HVAC systems in the building (actual and notional). It also lists some general information, such as the weather location of the building and the percentages of total building floor area occupied by the different activity types.

See APPENDIX A:, A.9 for a sample England and Wales *Building Regulations Compliance* document.

NB: You must close all output files before re-running the calculation (so the software can over-write them). Otherwise, an error message will be produced.

8.2.3. Data Reflection Report – Actual Building

This report contains all the data that SBEM uses to calculate the energy performance of the building along with some general details about the building (as input by the user) and can be attached to the building's Log Book. The information is presented in the following order:

- General details
- Building fabric details
- All systems other than HVAC
- HVAC system 1
  - Zone 1 in HVAC system 1
    - Envelope 1 of Zone 1
      - Window 1 in Envelope 1 of Zone 1
      - Door 1 in Envelope 1 of Zone 1
    - *Etc..for all other zones in HVAC system 1*

  Etc.. for all other HVAC systems

- Compliance Check Summary details

The report contains hyperlinks (in blue) to aid in navigation around the report. See Figure 89 for a screen shot of one of the *Data Reflection* Report and for examples of the hyperlinks.

NEW

The data in this report for the actual building is also produced in a more compact layout in pdf format (Figure 90). This report is more printer-friendly than the html one, and it can be printed either on A4 or A3 paper.

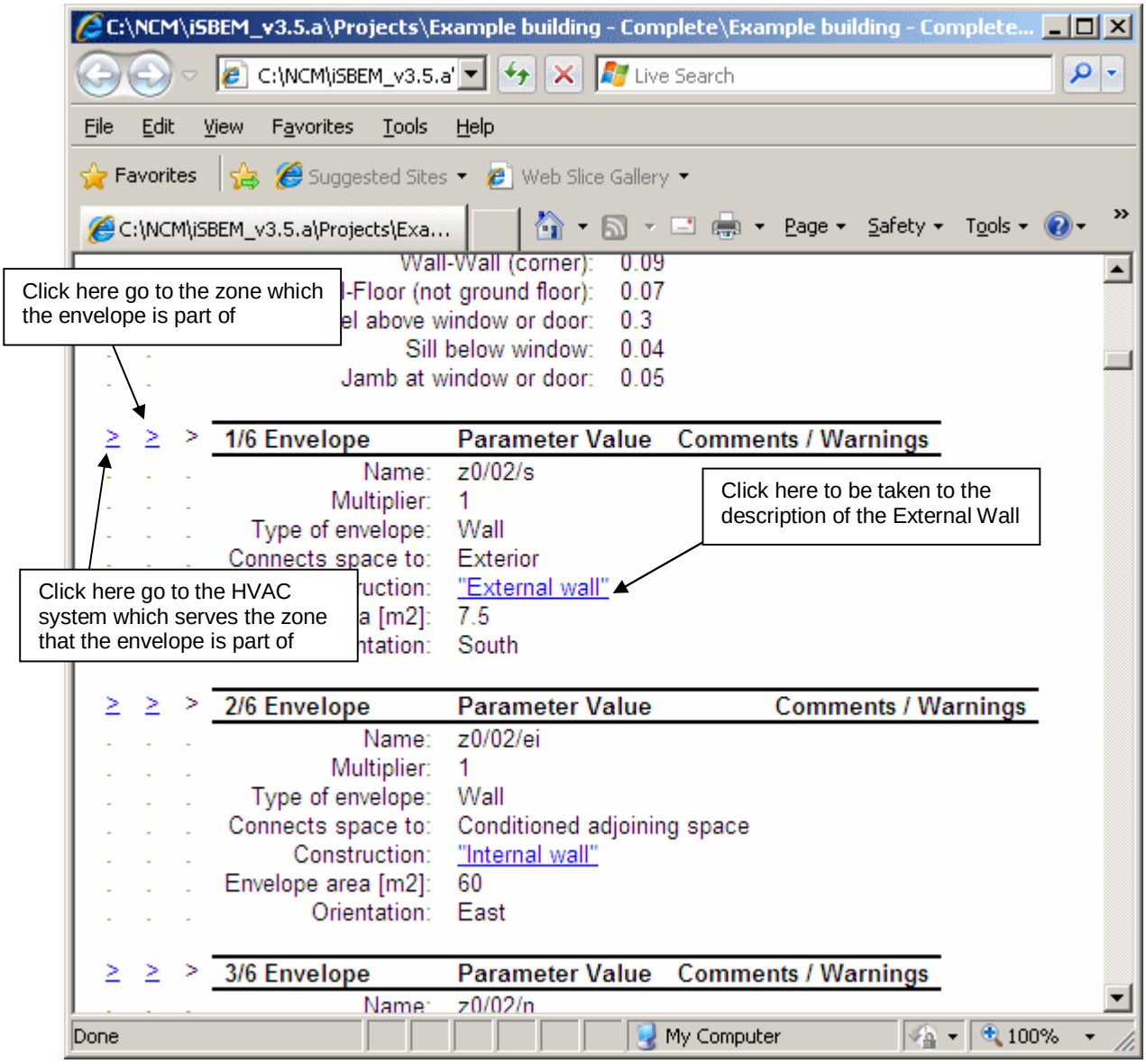

C:\NCM\iSBEM_v3.5.a\Projects\Example building - Complete\Example building - Complete...
File Edit View Favorites Tools Help
Favorites
Suggested Sites
Web Slice Gallery
Page Safety Tools
Wall-Wall (corner): 0.09
-Floor (not ground floor): 0.07
el above window or door: 0.3
Sill below window: 0.04
Jamb at window or door: 0.05
Click here go to the zone which the envelope is part of
1/6 Envelope Parameter Value Comments / Warnings
Name: z0/02/s
Multiplier: 1
Type of envelope: Wall
Connects space to: Exterior
uction: "External wall"
a [m2]: 7.5
ntation: South
Click here to be taken to the description of the External Wall
Click here go to the HVAC system which serves the zone that the envelope is part of
2/6 Envelope Parameter Value Comments / Warnings
Name: z0/02/ei
Multiplier: 1
Type of envelope: Wall
Connects space to: Conditioned adjoining space
Construction: "Internal wall"
Envelope area [m2]: 60
Orientation: East
3/6 Envelope Parameter Value Comments / Warnings
Name: z0/02/n
Done
My Computer
100%

Figure 89: Data Reflection report in html format

NB: The *Data Reflection* Reports in html format are generated, and the related access buttons become visible in the *Ratings* form, only if the relevant box is ticked in the *General* form > *File Options* tab > *System Configuration* sub-tab.

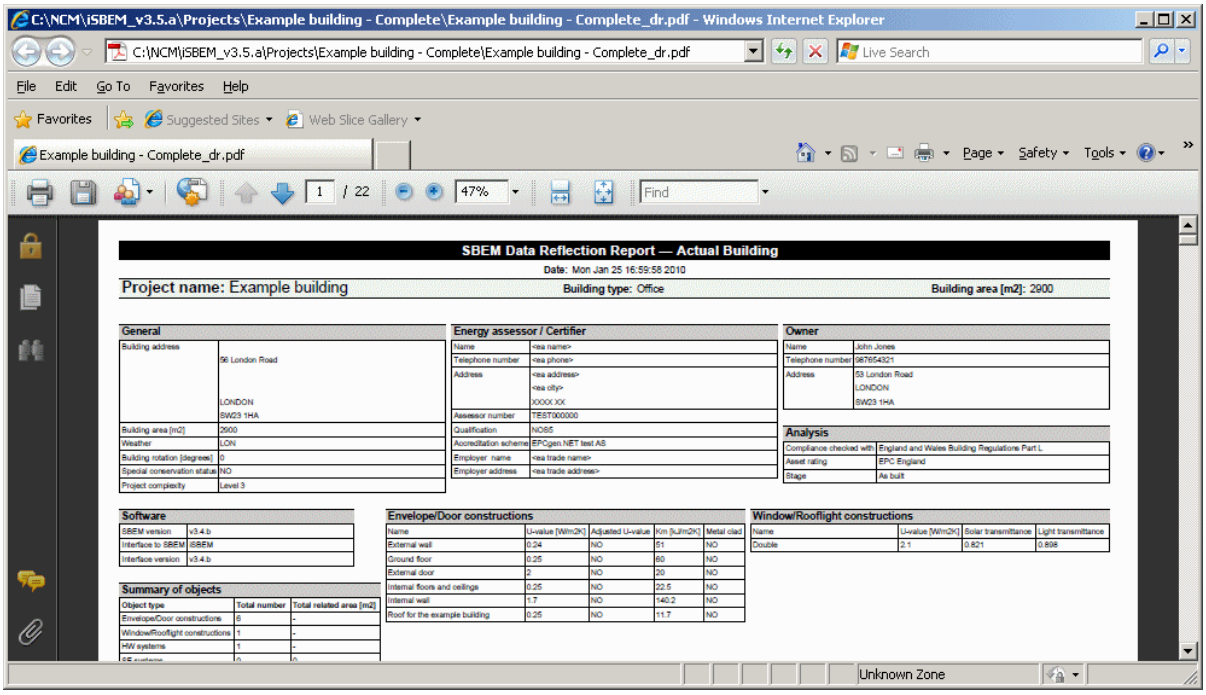


Figure 90: Data Reflection report in pdf format for the actual building

8.2.4. Data Reflection Report – Notional Building

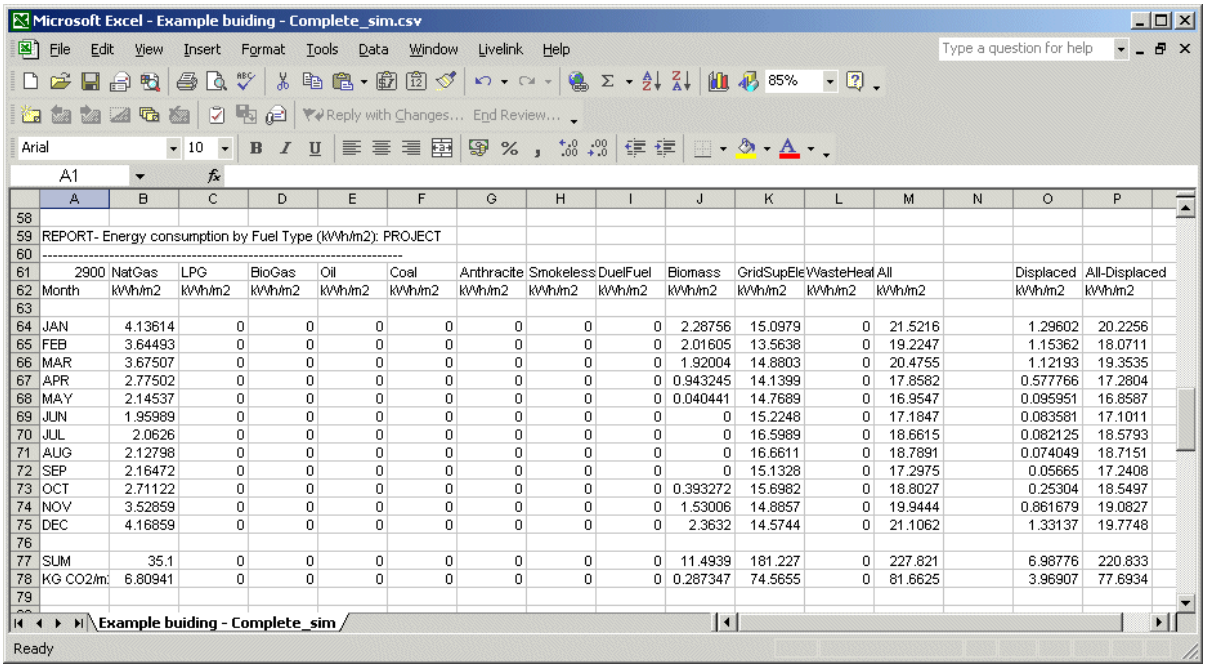
This report contains all the details on the notional building created by SBEM to compare with the actual building. It has the same structure and functionality as the *Data Reflection* report in html for the actual building described above.

NB: The *Data Reflection* Reports in html format are generated, and the related access buttons become visible in the *Ratings* form, only if the relevant box is ticked in the *General* form > *File Options* tab > *System Configuration* sub-tab.

8.2.5. Technical Output Report – Actual Building

This is a comma-separated-values '.csv' file (which can be opened using Microsoft Excel) and is intended for those who wish to do a more in-depth analysis of the results and create their own graphs. It is accessible from the project folder, as described in Section 8.2.12: Accessing the reports from the project folder. It contains the calculated values for (Figure 91):

- Monthly and annual energy use by fuel type (in MJ/m^2 and kWh/m^2).
- Monthly and annual energy use by end use (in MJ/m^2 and kWh/m^2).
- Annual CO_2 emissions by fuel type (in $kgCO_2/m^2$).
- Monthly and annual energy production (in MJ/m^2 and kWh/m^2) and CO_2 emissions (in $kgCO_2/m^2$) displaced by renewables, if applicable.



Microsoft Excel - Example buiding - Complete_sim.csv

REPORT- Energy consumption by Fuel Type (kWh/m2): PROJECT

2900	NatGas	LPG	BioGas	Oil	Coal	Anthracite	Smokeless	DuelFuel	Biomass	GridSupEle	WasteHeat	All	Displaced	All-Displaced
Month	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2	kWh/m2
JAN	4.13614	0	0	0	0	0	0	0	2.28756	15.0979	0	21.5216	1.29602	20.2256
FEB	3.64493	0	0	0	0	0	0	0	2.01605	13.5638	0	19.2247	1.15362	18.0711
MAR	3.67507	0	0	0	0	0	0	0	1.92004	14.8803	0	20.4755	1.12193	19.3535
APR	2.77502	0	0	0	0	0	0	0	0.943245	14.1399	0	17.8582	0.577766	17.2804
MAY	2.14537	0	0	0	0	0	0	0	0.040441	14.7689	0	16.9547	0.095951	16.8587
JUN	1.95989	0	0	0	0	0	0	0	0	15.2248	0	17.1847	0.083581	17.1011
JUL	2.0626	0	0	0	0	0	0	0	0	16.5989	0	18.6615	0.082125	18.5793
AUG	2.12798	0	0	0	0	0	0	0	0	16.6611	0	18.7891	0.074049	18.7151
SEP	2.16472	0	0	0	0	0	0	0	0	15.1328	0	17.2975	0.05665	17.2408
OCT	2.71122	0	0	0	0	0	0	0	0.393272	15.6982	0	18.8027	0.25304	18.5497
NOV	3.52859	0	0	0	0	0	0	0	1.53006	14.8857	0	19.9444	0.861679	19.0827
DEC	4.16859	0	0	0	0	0	0	0	2.3632	14.5744	0	21.1062	1.33137	19.7748
SUM	35.1	0	0	0	0	0	0	0	11.4939	181.227	0	227.821	6.98776	220.833
KG CO2/m	6.80941	0	0	0	0	0	0	0	0.287347	74.5655	0	81.6625	3.96907	77.6934

Example buiding - Complete_sim

Ready

Figure 91: Technical output report

8.2.6. Technical Output Report – Notional Building

This is a comma-separated-values '.csv' file (which can be opened using Microsoft Excel) for the notional building similar in format to the technical output report for the actual building described above.

8.2.7. Energy Performance Certificate

This report can be accessed from the *Ratings* form > *Asset Rating* tab > *Building Rating* sub-tab by clicking on the "Energy Performance Certificate" button and is stored in the same location as the project files as described in Section 8.2.12: Accessing the reports from the project folder. The file is in "pdf" format.

This report gives a summary of the energy performance of the building and its Asset Rating. It contains the following sections:

- Energy Performance Certificate: contains the title of the certificate, address of the building, and the Certificate Reference Number.
- Energy Performance Asset Rating: contains information about the building's calculated Asset Rating based on its predicted CO_2 emission rate (BER). It also shows where the building's Asset Rating fits on a scale of the building energy efficiency bands.
- Benchmarks: contains information about the Asset Ratings corresponding to the target CO_2 emission rate (TER) and the typical (stock average) CO_2 emission rate.
- Technical Information: contains information on the servicing strategy of the building (i.e., building environment – the service strategy that delivers the greatest total CO_2 emissions), the main heating fuel (the fuel which delivers the greatest total thermal output for space or water heating), and the complexity of the building.

NB: If none of the zones in the building have been defined as conditioned, the "building environment" will be set by the calculation to be "Unconditioned".

NB: If none of the zones in the building as defined have space or water heating energy consumption, the "main heating fuel" will be set by the calculation to be "Other".

NB: Permanently unconditioned buildings are different to those which are expected to be conditioned later on, and which should be modelled as per the guidance in CLG's publication: "Improving the energy efficiency of our buildings: A guide to energy performance certificates for the construction, sale and let of non-dwellings" which can be accessed from www.communities.gov.uk/publications/planningandbuilding/nondwelling.

NB: For Scotland, the EPC also displays the top 6 of the short payback NCM recommendations. If there are user-defined or user-edited recommendations, then the EPC will display up to 3 user recommendations with the shortest payback and the top 3 of the short payback NCM recommendations.

NB: For Scotland, the EPC can also display the potential rating and energy band with improvements if input by the Energy Assessor. **SBEM does not calculate the potential improved rating with recommendations. This value is input by the user.** If the Energy Assessor does not want a question mark to appear in the Ratings form and the EPC, the improved rating value needs to be entered by the Energy Assessor in the "Rating with improvements" field in the *General* form > *General Information* tab > *Project Detail*s sub-tab. Energy Assessors can use iSBEM to arrive at that rating value by making a copy of the original completed nct file containing the building model in iSBEM in which they can implement their selected recommendations (out of the Recommendations report - whether NCM or added by the Energy Assessor), run the calculation, and obtain the potential improved rating. They can then input that same value in the original nct file of the building (as described above) and re-run the calculation for the value to appear on the original EPC for Scotland.

- Administrative Information: contains the energy assessor's details, Property Reference Number, assessment software, the certificate's validity dates, and the Recommendations Report Reference Number (the second output file from EPCgen).

See APPENDIX A:, A.6 for a sample *Energy Performance Certificate* for the Example building.

NB: You must close all output files before re-running the calculation (so the software can over-write them). Otherwise, an error message will be produced.

8.2.8. Recommendations Report

This report can be accessed from the *Ratings* form > *Asset Rating* tab > *Building Rating* sub-tab by clicking on the "EPC Recommendation Report" button and is stored in the same location as the project files, as described in Section 8.2.12: Accessing the reports from the project folder. The file is in "pdf" format.

This report contains some administrative information about the building and the energy assessor and a list of recommendations (generated by the calculation and input by the energy assessor) for energy-efficiency improvements in the building. It contains the following sections:

- Administrative Information: contains information on the Property Reference Number, the software used to produce the report, and the validity dates of the report.
- Energy Assessors Details: contains details about the energy assessor.
- Background: contains information on the legislation and the servicing strategy of the property.
- Introduction: contains information on the calculation tool used.
- Recommendations: contains a list of recommendations, edited by the energy assessor, for the improvement of the energy performance of the building and their respective potential impact on the CO_2 emission rate of the building. The recommendations are grouped into the following sub-sections: short payback (up to 15 recommendations), medium payback (up to 10 recommendations), long payback (up to 5 recommendations),

and other recommendations created by the energy assessor (up to 10 recommendations).

NB: Only recommendations that are defined as applicable to the whole building, i.e., the parameter "Applicable to" has been set to 'BUILDING', appear in the official Recommendations report. All the defined recommendations, however, will appear in SBEM's Secondary Recommendations report.

- Next Steps: contains information on the steps that need to be taken following the production of the reports.
- Glossary: contains definitions of some of the terms used in the report.

See APPENDIX A:, A.6 for a sample *Recommendations Report* for the Example building.

NB: You must close all output files before re-running the calculation (so the software can over-write them). Otherwise, an error message will be produced.

NB: The NCM recommendations are generated for the building and its energy systems when operated according to standard schedules appropriate to the general activities in the building. The Energy Assessor is expected to use his or her knowledge to remove inappropriate ones and possibly to add additional ones. If the Energy Performance Rating calculation has made extensive use of default values, some of the recommendations may be based on uncertain assumptions. These recommendations do not cover the quality of operation or maintenance of the building and its systems. There are frequently significant opportunities for energy and carbon savings in these areas and a full "energy audit" to identify them is strongly recommended.

8.2.9. Technical Output Report – Reference Building

This is a comma-separated-values '.csv' file (which can be opened using Microsoft Excel) for the reference building similar in format to the technical output report for the actual building described previously (see Section 8.2.5: Technical Output Report – Actual Building).

8.2.10. Technical Output Report – Typical Building

This is a comma-separated-values '.csv' file (which can be opened using Microsoft Excel) for the typical building similar in format to the technical output report for the actual building described previously (see Section 8.2.5: Technical Output Report – Actual Building).

8.2.11. SBEM Secondary Recommendations Report

This report is generated if either 'EPC England', 'EPC Wales', or 'EPC Northern Ireland' were selected as the "Purpose of Analysis" in the *General* form > *General Information* tab > *Project Details* sub-tab, and the calculation was run to generate the Energy Performance Certificate. It can be accessed from the *Ratings* form > *Asset Rating* tab > *Building Rating* sub-tab by clicking on the "Supporting Recommendations" button and is stored in the same location as the project files as described in Section 8.2.12: Accessing the reports from the project folder. The file is in "pdf" format.

This report gives a summary of building's energy and CO_2 emissions performance for the different end-use categories and a full list of recommendations (generated by the calculation and/or input by the user) for energy-efficiency improvements in the building (i.e., not just the recommendations that appear in the official *Recommendations* report described in section 8.2.8: Recommendations Report. It provides:

- The name and type of the building.
- A key to the colour codes used in displaying the recommendations.

- The current performance of the building for each of the following categories, such as the attributed percentage of the total building's CO_2 emissions and overall energy performance:
  - Heating
  - Cooling
  - Hot water
  - Lighting
  - Renewables
  - Overheating
  - Envelope
  - Fuel-Switching
  - Auxiliary
  - Other
- Recommendations related to each of the above categories, and for each recommendation, a set of information is displayed, such as the potential impact of implementing the recommendation on the energy performance and CO_2 emissions of the building, the potential saving in CO_2 emissions per pound spent, and any additional comments input by the energy assessor.

See APPENDIX A:, A.8 for a sample *SBEM Secondary Recommendations Report* for the Example building.

8.2.12. Accessing the reports from the project folder

All of the above reports are accessible from the specific project folder (created when the project was first created, see Section 4.4: Creating new and opening existing projects). The default location for this folder is within the main **Projects** folder within the **iSBEM_v3.5.a** folder, e.g., "C:\NCM\\iSBEM_v3.5.a\ Projects\Example building-complete". The reports have the following file names and extensions:

Output reports when running SBEM for building regulations compliance checking:

1. SBEM Main Output Document – "project name"_**sbem.pdf**
2. SBEM BRUKL Output Document: Compliance with Building Regulations ('Specification Information' for Scottish Building Regulations) – "project name"_**brukl.pdf**

NEW

3. Data Reflection Report - Actual Building – "project name"_**dr.pdf**
4. Data Reflection Report - Actual Building – "project name"_**dr.htm**
5. Data Reflection Report - Notional Building – "project name"_**not_dr.htm**
6. Technical Output Report - Actual Building – "project name"_**sim.csv**
7. Technical Output Report - Notional Building – "project name"_**not_sim.csv**

Output reports when running SBEM for Energy Performance Certificates:

1. SBEM Main Output Document – "project name"_**sbem. pdf**
2. Energy Performance Certificate – "project name"_**epc[epc].pdf**
3. EPC Recommendations Report – "project name"_**epc[rec].pdf**
4. Data Reflection Report - Actual Building – "project name"_**dr.htm**

NEW

5. Data Reflection Report - Actual Building – "project name"_**dr.pdf**
6. Technical Output Report - Actual Building – "project name"_**sim.csv**
7. Technical Output Report - Notional Building – "project name"_**not_sim.csv**
8. Technical Output Report - Reference Building – "project name"_**ref_sim.csv**
9. Technical Output Report - Typical Building – "project name"_**typ_sim.csv**
10. SBEM Secondary Recommendations Report.– "project name"_**epc[srec].pdf**

XML file when running SBEM for official submission of Energy Performance Certificates for England, Wales, and Northern Ireland (<u>for assessors accredited by an Accreditation Scheme Provider that allows Energy Assessors to generate the final EPC documents for lodgement through the Energy Assessors' computers)</u> will be named as follows:

1. XML file for the Energy Performance Certificate and the EPC Recommendations Report – "EPC reference number"**. xml**

If the EPC is generated in Welsh as well as in English (by ticking the relevant tick box in the *General* form > *General Information* tab > *Project Details* sub-tab), the file containing the Welsh EPC will be named as follows:

1. Energy Performance Certificate in Welsh – "project name"_**epcw.pdf**

<u>For assessors accredited by an Accreditation Scheme Provider that generates the final EPC documents for lodgement in a central system for the Accreditation Scheme</u>, the IAS file required by the Accreditation Scheme Provider will be named as follows:

1. IAS file required by the Accreditation Scheme Provider – "project name"**. ias**

The project folder for the "Example building – Complete" file is shown in Figure 92 with the output reports highlighted when running SBEM for building regulations compliance checking and in Figure 93 with the output reports highlighted when running SBEM for Energy Performance Certificates.

Also highlighted is **the NCT file which is the file that is read by iSBEM and where all the input data has been stored.** If you need to share a project with your colleagues, this is the only file you need to send them. They will be able to open it through iSBEM and generate all the other files.

Other files highlighted in Figure 92 are 3 error files (with the extension **.err**) which you should check for any warnings or error messages generated by SBEM or BRUKL during the calculation. These are text files. Similarly, in Figure 93, 3 error files are highlighted which contain warnings or error messages generated by SBEM or EPCgen. The contents of these files can also be viewed in the *Calculation Errors* sub-tab in the *Ratings* form (see section 8.1.2: Asset Rating tab).

You will also notice that the there are 2 further *Data Reflection* Reports with the extension '.csv'. These files contain the same data as in the *Data Reflection* '.htm' files described above but in a comma-separated-values format (which can be opened using Microsoft Excel).

NB: You <u>must</u> close all output files before re-running the calculation (so the software can over-write them). Otherwise, an error message will be produced.

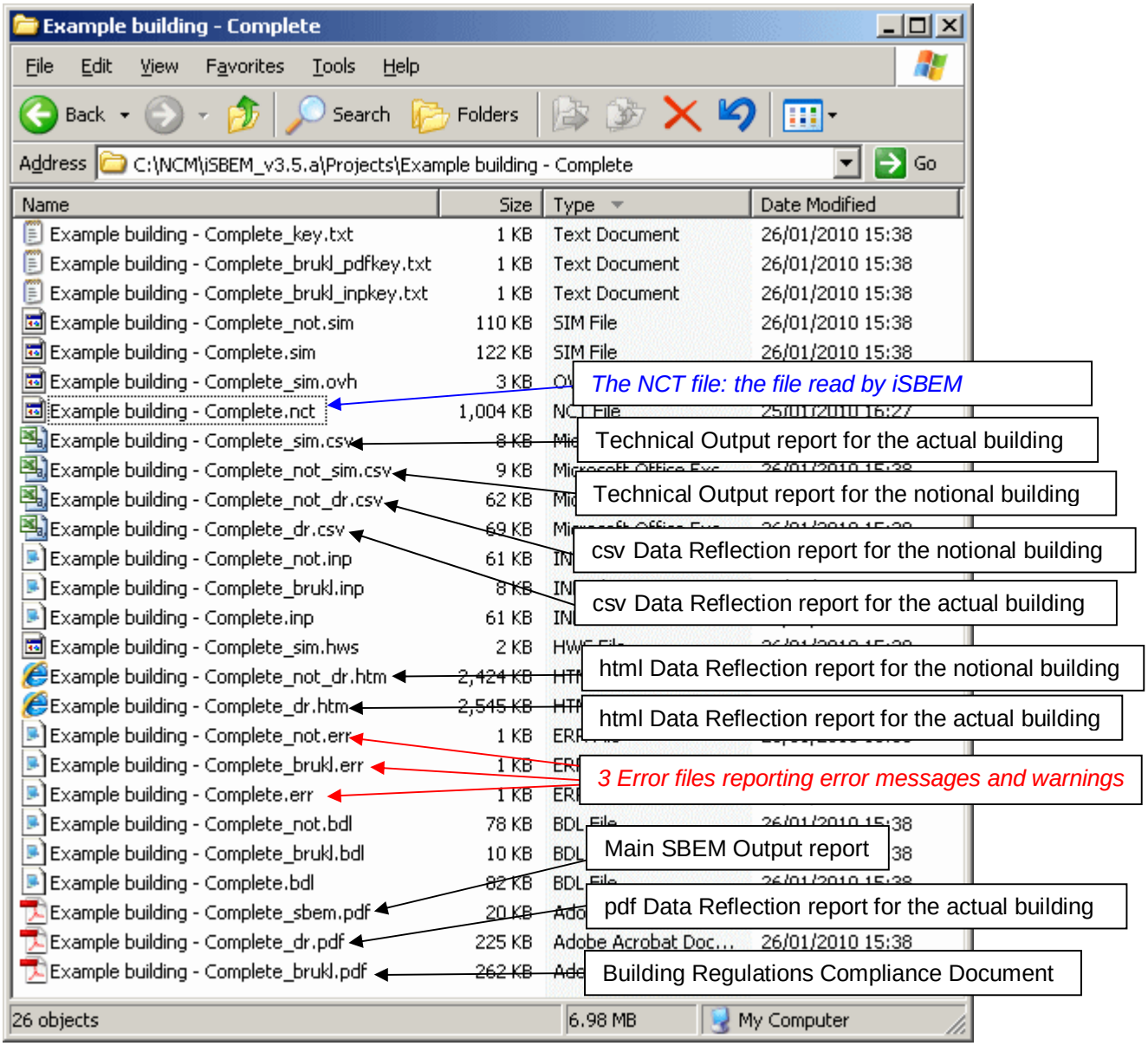

Example building - Complete
File Edit View Favorites Tools Help
Back Search Folders
Address C:\NCM\iSBEM_v3.5.a\Projects\Example building - Complete
Go
Name Size Type Date Modified
Example building - Complete_key.txt 1 KB Text Document 26/01/2010 15:38
Example building - Complete_brukl_pdfkey.txt 1 KB Text Document 26/01/2010 15:38
Example building - Complete_brukl_inpkey.txt 1 KB Text Document 26/01/2010 15:38
Example building - Complete_not.sim 110 KB SIM File 26/01/2010 15:38
Example building - Complete.sim 122 KB SIM File 26/01/2010 15:38
Example building - Complete_sim.ovh 3 KB
Example building - Complete.nct 1,004 KB
Example building - Complete_sim.csv
Example building - Complete_not_sim.csv 9 KB
Example building - Complete_not_dr.csv 62 KB
Example building - Complete_dr.csv
Example building - Complete_not.inp 61 KB
Example building - Complete_brukl.inp
Example building - Complete.inp 61 KB
Example building - Complete_sim.hws 2 KB
Example building - Complete_not_dr.htm 2,424 KB
Example building - Complete_dr.htm 2,545 KB
Example building - Complete_not.err 1 KB
Example building - Complete_brukl.err 1 KB
Example building - Complete.err 1 KB
Example building - Complete_not.bdl 78 KB
Example building - Complete_brukl.bdl 10 KB
Example building - Complete.bdl
Example building - Complete_sbem.pdf
Example building - Complete_dr.pdf 225 KB Adobe Acrobat Doc... 26/01/2010 15:38
Example building - Complete_brukl.pdf
26 objects 6.98 MB My Computer
The NCT file: the file read by iSBEM
Technical Output report for the actual building
Technical Output report for the notional building
csv Data Reflection report for the notional building
csv Data Reflection report for the actual building
html Data Reflection report for the notional building
html Data Reflection report for the actual building
3 Error files reporting error messages and warnings
Main SBEM Output report
pdf Data Reflection report for the actual building
Building Regulations Compliance Document

Figure 92: Contents of the Projects folder showing the SBEM output reports when running SBEM for building regulations compliance checking

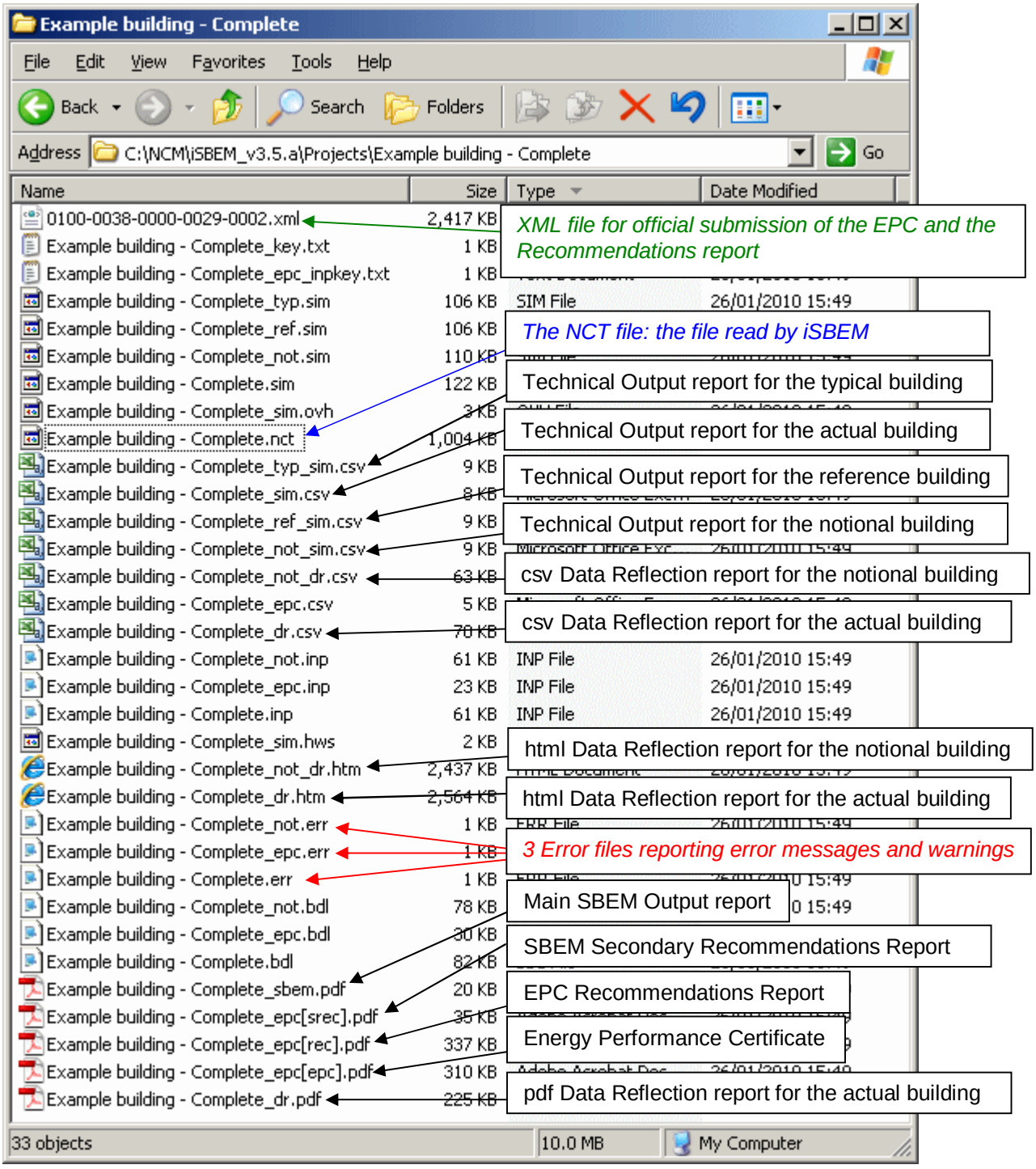

Example building - Complete
File Edit View Favorites Tools Help
Back Search Folders
Address C:\NCM\iSBEM_v3.5.a\Projects\Example building - Complete
Go
Name Size Type Date Modified
0100-0038-0000-0029-0002.xml 2,417 KB
Example building - Complete_key.txt 1 KB
Example building - Complete_epc_inpkey.txt 1 KB
Example building - Complete_typ.sim 106 KB SIM File 26/01/2010 15:49
Example building - Complete_ref.sim 106 KB
Example building - Complete_not.sim 110 KB
Example building - Complete.sim 122 KB
Example building - Complete_sim.ovh 3 KB
Example building - Complete.nct 1,004 KB
Example building - Complete_typ_sim.csv 9 KB
Example building - Complete_sim.csv 8 KB
Example building - Complete_ref_sim.csv 9 KB
Example building - Complete_not_sim.csv 9 KB
Example building - Complete_not_dr.csv 63 KB
Example building - Complete_epc.csv 5 KB
Example building - Complete_dr.csv 70 KB
Example building - Complete_not.inp 61 KB INP File 26/01/2010 15:49
Example building - Complete_epc.inp 23 KB INP File 26/01/2010 15:49
Example building - Complete.inp 61 KB INP File 26/01/2010 15:49
Example building - Complete_sim.hws 2 KB
Example building - Complete_not_dr.htm 2,437 KB
Example building - Complete_dr.htm 2,564 KB
Example building - Complete_not.err 1 KB
Example building - Complete_epc.err 1 KB
Example building - Complete.err 1 KB
Example building - Complete_not.bdl 78 KB
Example building - Complete_epc.bdl 30 KB
Example building - Complete.bdl 82 KB
Example building - Complete_sbem.pdf 20 KB
Example building - Complete_epc[srec].pdf 35 KB
Example building - Complete_epc[rec].pdf 337 KB
Example building - Complete_epc[epc].pdf 310 KB
Example building - Complete_dr.pdf 225 KB
33 objects 10.0 MB My Computer
XML file for official submission of the EPC and the Recommendations report
The NCT file: the file read by iSBEM
Technical Output report for the typical building
Technical Output report for the actual building
Technical Output report for the reference building
Technical Output report for the notional building
csv Data Reflection report for the notional building
csv Data Reflection report for the actual building
html Data Reflection report for the notional building
html Data Reflection report for the actual building
3 Error files reporting error messages and warnings
Main SBEM Output report
SBEM Secondary Recommendations Report
EPC Recommendations Report
Energy Performance Certificate
pdf Data Reflection report for the actual building

Figure 93: Contents of the Projects folder showing the SBEM output reports when running SBEM for Energy Performance Certificates

APPENDIX A: Tutorial building details and iSBEM output documentation

A.1. Building description

The building is located in London. It is rectangular in shape with dimensions of 50 m x 30 m. It provides space for offices, a supermarket, and a coffee shop.

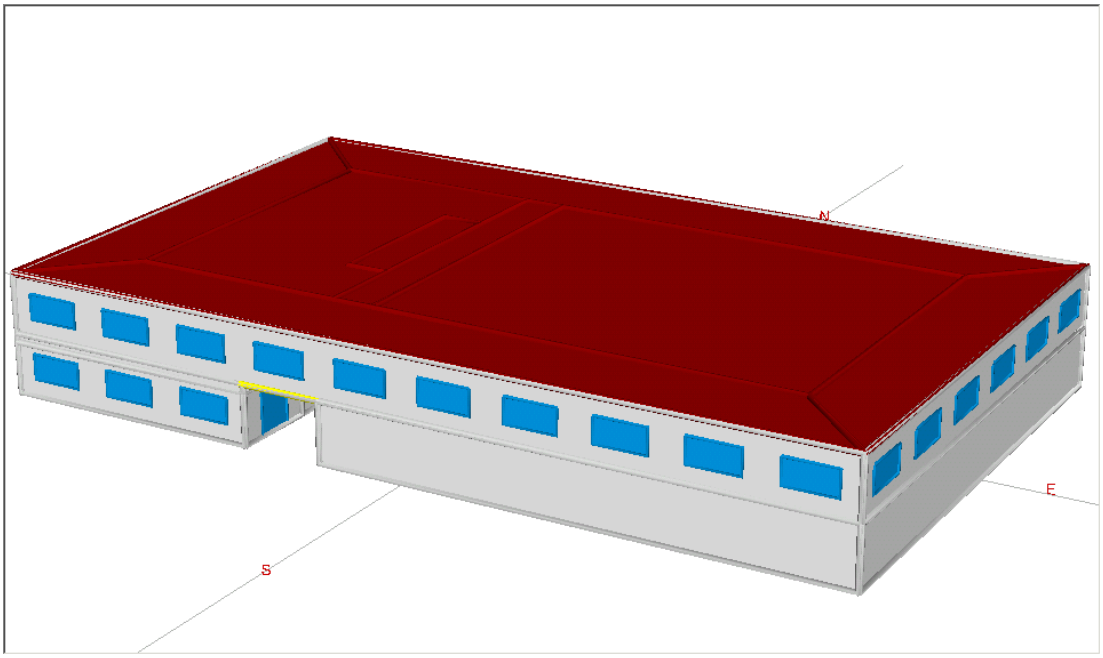


Figure 94: 3D view of the Example building

It has two floors. The supermarket and the coffee shop are located on the ground floor, with an outdoor passage between them, and the offices are located on the first floor. The first floor is accessible by stairs and lifts.

Height inside the building:

Ground floor: 3 m floor to floor

First floor: 3 m floor to soffit

All windows are set-back by 30 cm. This gives a transmission factor of 0.8. The window sill height is 1 m. The doors are 2.5 m high.

The supermarket has an auxiliary room (see drawings), and there are another two auxiliary rooms in the coffee shop. There are toilets serving the offices on the first floor.

A.1. Constructions

- **Roof:** Flat roof, 2002 Building Regulations
- **Ground floor:** Solid floor
- **Internal floor/ceiling:** Suspended Floor, 2002 Building Regulations
- **Internal Walls:** Un-insulated concrete wall
- **External Wall:** U-value = 0.24W/m^2K, κ_m = 51KJ/m^2
- **Glazing**: All the glazing in the building is double glazing.
  U-value = 2.1W/m^2K, T-Solar = 0.821 and L-Solar = 0.898
- **Doors:** U-value = 2W/m^2K, κ_m = 20KJ/m^2K.

The **air permeability** of the building at 50pa is 8m^3/h.m^2.

A.2. Systems

HVAC: System is a single duct VAV system with LTHW boiler using natural gas as fuel. It has heat recovery (Plate heat exchanger). The chiller is air-cooled with less than 100 kW capacity. Both the chiller and the boiler appear on the ETL after 2001. The system has provision for metering and has M&T with alarms for “out of range” values. The ductwork leakage meets the CEN standard Class B, and the AHU has been tested and meets the CEN standard Class L1. The specific fan power is 2.2 W/(l/s).

The HVAC system serves all the zones in the building except for the circulation spaces and the toilets.

Lighting: No information apart from lamp types = T8 fluorescents. There is manual switching and photoelectric dimming with a back sensor in the coffee shop and the office. There is manual switching in all other areas.

Hot water: Provided by the HVAC system boiler.

Ventilation: Toilets have mechanical exhaust with 5 l/s.m^2.

A.3. Zoning of the building

The building has been divided into **19** zones:

z0/01east: The coffee shop on the ground floor – core and unglazed east perimeter area.

z0/01north, z0/01northwest, z0/01west, z0/01south west, and z0/01south: The coffee shop on the ground floor – glazed perimeter areas.

z0/02: The circulation area / staircase / lift area on the ground floor.

z0/03: The supermarket on the ground floor.

z1/01centre: The open plan office area on the first floor – core zone.

z1/01north, z1/01northeast, z1/01east, z1/01southeast, z1/01south, z1/01southwest, z1/01west, and z1/01northwest: The open plan office area on the first floor – glazed perimeter areas.

z1/02: The circulation area / staircase / lift area on the first floor.

z1/03: The toilets on the first floor.

As you can see in Figure 95: Ground floor plan, the supermarket and the coffee shop contain smaller (auxiliary) areas which could be considered as separate zones. For e.g., it would be possible to separate the supermarket (z0/03) into two zones: the main area and the smaller room at the west end of the space. Similarly, the coffee shop core and east perimeter zone (z0/01/east) could be split into two zones. For simplicity, however, it has been assumed that the activities of the auxiliary rooms within the supermarket and coffee shop do not vary from the activity within the main areas. Hence, these auxiliary spaces have been absorbed within the main zones. More details on zoning can be found in Section 3.3: Zoning guide – How to zone your building.

Table 17 below shows the area information you need for entering the geometry of the zones into iSBEM. See Section 3.5 for a description of the nomenclature used in this example. (e.g.: z0/01north/n = external north wall of zone z0/01/north).

GROUND FLOOR					
Zones	**Area (m^2)**	**Envelope**	**Area (m^2)**	**Windows/Doors**	**Area (m^2)**
z0/01north[xvii]	54	z0/01north/n	27	z0/01north/n/g	8.1
		z0/01north/e	18	z0/01north/e/d	3.75
		z0/01north/f	54		
		z0/01north/ci	54		
z0/01east	162	z0/01east/e	54		
		z0/01east/f	162		
		z0/01east/ci	162		
z0/01south	54	z0/01south/s	27	z0/01south/s/g	8.1
		z0/01south/e	18	z0/01south/e/d	3.75
		z0/01south/f	54		
		z0/01south/ci	54		
z0/01southwest	36	z0/01southwest/s	18	z0/01southwest/s/g	5.4
		z0/01southwest/w	18	z0/01southwest/w/g	5.4
		z0/01southwest/f	36		
		z0/01southwest/ci	36		
z0/01west	108	z0/01west/w	54	z0/01west/w/g	16.2
		z0/01west/f	108		
		z0/01west/ci	108		
z0/01northwest	36	z0/01northwest/n	18	z0/01northwest/n/g	5.4
		z0/01northwest/w	18	z0/01northwest/w/g	5.4
		z0/01northwest/f	36		
		z0/01northwest/ci	36		
z0/02	50	z0/02/n	7.5		
		z0/02/ei	60		
		z0/02/s	7.5		
		z0/02/w	60	z0/02/w/d	2 x 3.75 =7.5
		z0/02/f	50		
		z0/02/ci	50		
z0/03	900	z0/03/n	90		
		z0/03/e	90		
		z0/03/s	90		
		z0/03/w	30	z0/03/w/d	2 x 3.75 =7.5
		z0/03/wi	60		
		z0/03/f	900		
		z0/03/ci	900		

[xvii] For a description of nomenclature used in the example, see Section 3.5.

FIRST FLOOR					
Zones	**Area (m^2)**	**Envelope**	**Area (m^2)**	**Windows/Doors**	**Area (m^2)**
z1/01north	225.5	z1/01north/n	114	z1/01north/n/g	34.2
		z1/01north/ni	7.5		
		z1/01north/ei	3		
		z1/01north/wi	3		
		z1/01north/fe	27.5		
		z1/01north/fi	198		
		z1/01north/c	225.5		
z1/01northeast	36	z1/01northeast/n	18	z1/01northeast/n/g	5.4
		z1/01northeast/e	18	z1/01northeast/e/g	5.4
		z1/01northeast/fi	36		
		z1/01northeast/c	36		
z1/01east	108	z1/01east/e	54	z1/01east/e/g	16.2
		z1/01east/fi	108		
		z1/01east/c	108		
z1/01southeast	36	z1/01southeast/e	18	z1/01southeast/e/g	5.4
		z1/01southeast/s	18	z1/01southeast/s/g	5.4
		z1/01southeast/fi	36		
		z1/01southeast/c	36		
z1/01south	225.5	z1/01south/s	114	z1/01south/s/g	34.2
		z1/01south/si	7.5		
		z1/01south/ei	3		
		z1/01south/wi	3		
		z1/01south/fe	27.5		
		z1/01south/fi	198		
		z1/01south/c	225.5		
z1/01southwest	36	z1/01southwest/s	18	z1/01southwest/s/g	5.4
		z1/01southwest/w	18	z1/01southwest/w/g	5.4
		z1/01southwest/fi	36		
		z1/01southwest/c	36		
z1/01west	108	z1/01west/w	54	z1/01west/w/g	16.2
		z1/01west/fi	108		
		z1/01west/c	108		
z1/01northwest	36	z1/01northwest/n	18	z1/01northwest/n/g	5.4
		z1/01northwest/w	18	z1/01northwest/w/g	5.4
		z1/01northwest/fi	36		
		z1/01northwest/c	36		
z1/01centre	614	z1/01centre/ei	54		
		z1/01centre/wi	54		
		z1/01centre/fe	20		
		z1/01centre/fi	594		
		z1/01centre/c	614		
		z1/01centre/ni	7.5		
		z1/01centre/si	7.5		
z1/02	50	z1/02/ni	7.5		
		z1/02/ei	60		
		z1/02/si	7.5		
		z1/02/wi	30		
		z1/02/wi.1	30		
		z1/02/fi	50		

		z1/02/c	50	
z1/03	25	z1/03/ni	7.5	
		z1/03/ei	30	
		z1/03/si	7.5	
		z1/03/wi	30	
		z1/03/fe	25	
		z1/03/c	25	

Other information	
Window to wall (%)	**30**
Door area (m^2)	**3.75**

Table 17: Zoning summary and dimensions of the Example building

A.4. Drawings

The next figures show architectural drawings and building zoning for each floor of the Example building.

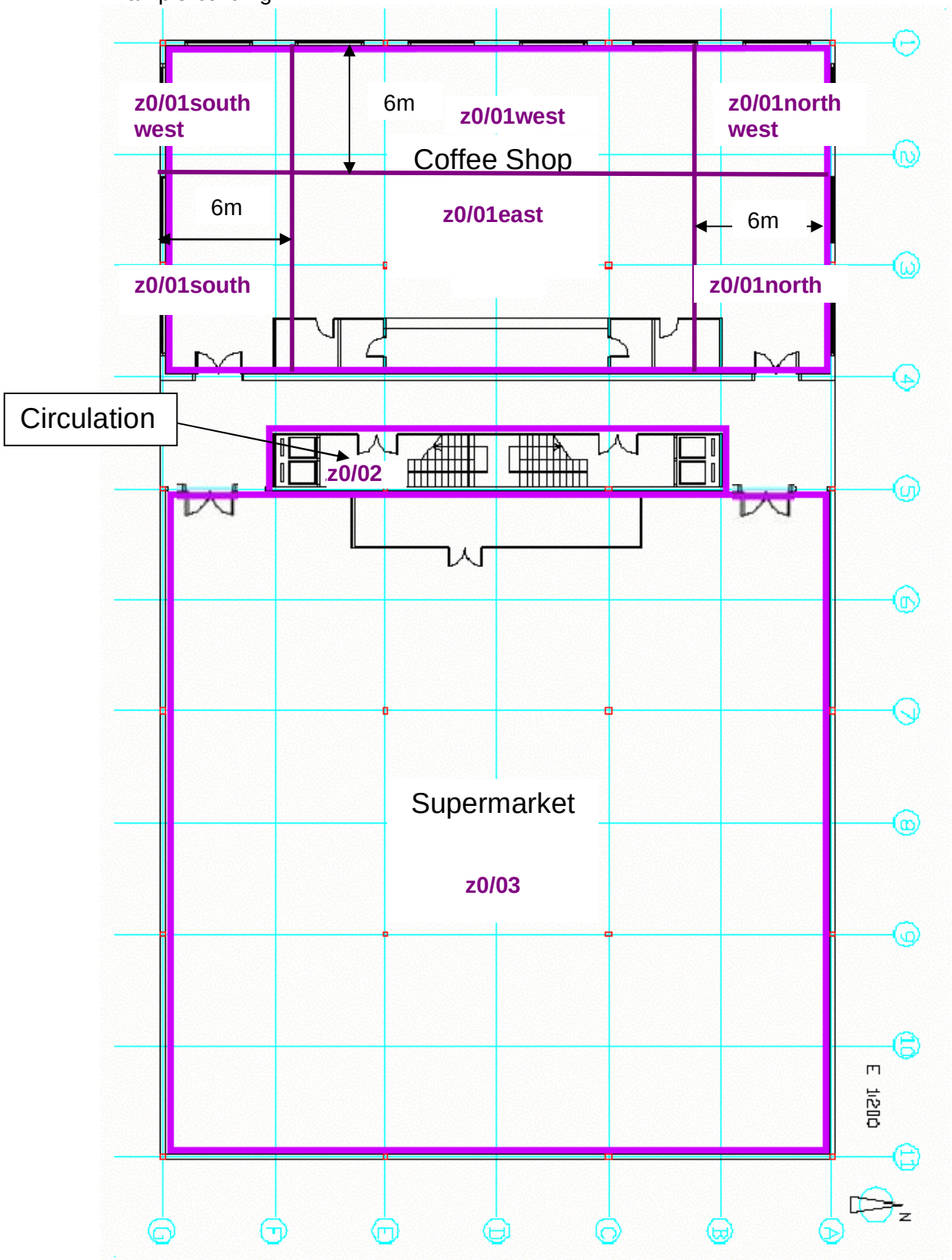


Figure 95: Ground floor plan

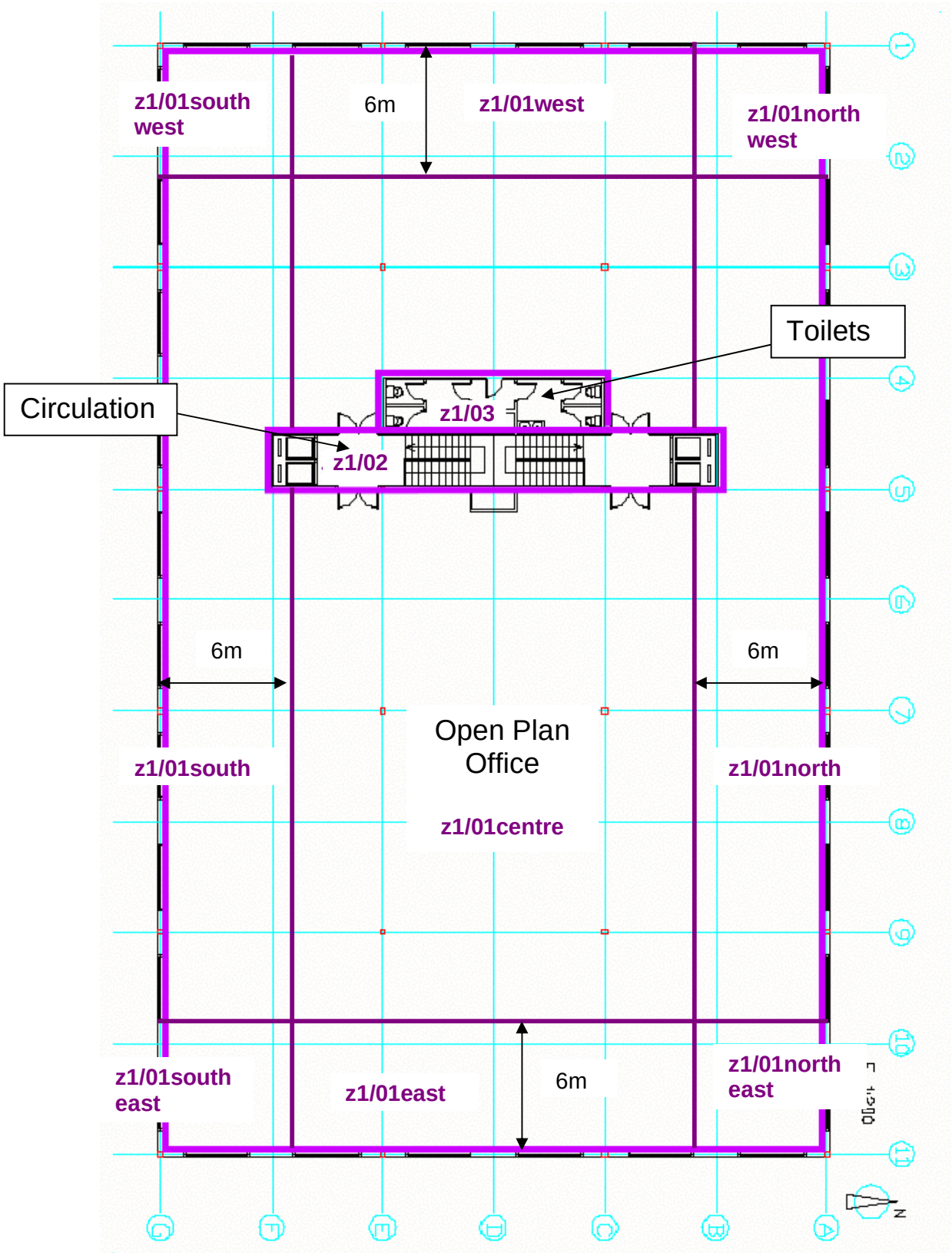


Figure 96: First floor plan

A.5. SBEM Main Output Document for Example Building

SBEM Main Calculation Output Document

Tue Jan 26 16:03:08 2010

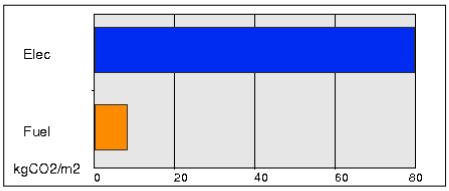
Building name

Example building

Building type: Office

SBEM is an energy calculation tool for the purpose of assessing and demonstrating compliance with Building Regulations (Part L for England and Wales, Section 6 for Scotland, Part F for Northern Ireland, Part L for Republic of Ireland and Building Bye-laws Jersey Part 11) and to produce Energy Performance Certificates and Building Energy Ratings. Although the data produced by the tool may be of use in the design process, **SBEM is not intended as a building design tool.**

Building Energy Performance and CO2 emissions

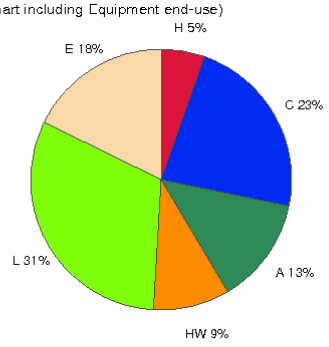


0 kgCO2/m2 displaced by the use of renewable sources.

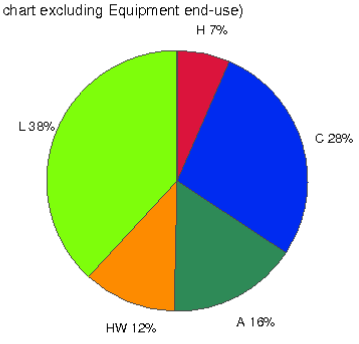
Building area is 2900m2

Annual Energy Consumption

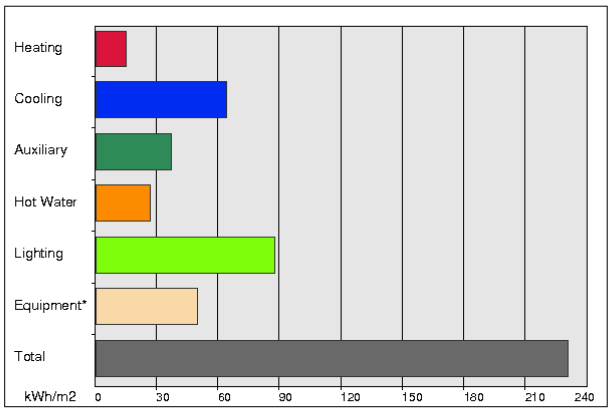
(Pie chart including Equipment end-use)

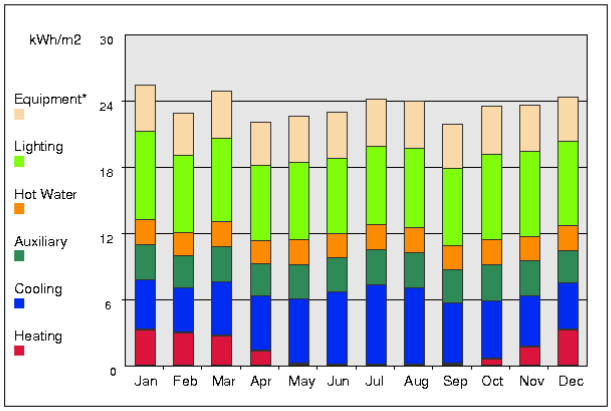


(Pie chart excluding Equipment end-use)



(*) Although energy consumption by equipment is shown in the graphs, the CO2 emissions associated with this end-use have not been taken into account when producing the rating.





A.6. Energy Performance Certificate for Example Building

This is not a valid certificate

Energy Performance Certificate

HM Government

Non-Domestic Building

56 London Road
LONDON
SW23 1HA

Certificate Reference Number:
0100-0038-0000-0029-0002

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Asset Rating

More energy efficient

A+ Net zero CO_2 emissions

A 0-25

B 26-50

C 51-75

D 76-100

E 101-125

F 126-150

G Over 150

63 This is how energy efficient the building is.

Less energy efficient

Technical information

Main heating fuel:	Natural Gas
Building environment:	Air Conditioning
Total useful floor area (m^2):	2900
Building complexity (NOS level):	3
Building emission rate ($kgCO_2/m^2$):	87.74

Benchmarks

Buildings similar to this one could have ratings as follows:

59 If newly built

113 If typical of the existing stock

ONLY FOR ILLUSTRATION

Administrative information

This is an Energy Performance Certificate as defined in SI2007:991 as amended

Assessment Software:	iSBEM v3.5.a using calculation engine SBEM v3.5.a.0
Property Reference:	000000000000
Assessor Name:	Firstname Surname 1
Assessor Number:	TEST000000
Accreditation Scheme:	EPCgen.NET test AS
Employer/Trading Name:	<ea trade name>
Employer/Trading Address:	<ea trade address>
Issue Date:	04 Jun 2010
Valid Until:	03 Jun 2020 (unless superseded by a later certificate)
Related Party Disclosure:	Not related to the owner

Recommendations for improving the property are contained in Report Reference Number: 0000-2090-0040-1000-0803

If you have a complaint or wish to confirm that the certificate is genuine

Details of the assessor and the relevant accreditation scheme are on the certificate. You can get contact details of the accreditation scheme from the Government's website at www.communities.gov.uk/epbd, together with details of the procedures for confirming authenticity of a certificate and for making a complaint.

This is not a valid certificate
ONLY FOR ILLUSTRATION

CARBON TRUST

For advice on how to take action and to find out about technical and financial assistance schemes to help make buildings more energy efficient visit **www.carbontrust.co.uk** or call us on **0800 085 2005**

A.7. Recommendations Report for Example Building

This is not a valid certificate

0000-2090-0040-1000-0803

Recommendation Report

HM Government

Report Reference Number: 0000-2090-0040-1000-0803

56 London Road
LONDON
SW23 1HA

Building Type(s): Office

ADMINISTRATIVE INFORMATION	
Issue Date:	04 Jun 2010
Valid Until:	03 Jun 2020 (*)
Total Useful Floor Area (m^2):	2900
Calculation Tool Used:	iSBEM v3.5.a using calculation engine SBEM v3.5.a.0
Property Reference:	000000000000
Energy Performance Certificate for the property is contained in Report Reference Number: 0100-0038-0000-0029-0002	

ENERGY ASSESSOR DETAILS	
Assessor Name:	Firstname Surname 1
Employer/Trading Name:	<ea trade name>
Employer/Trading Address:	<ea trade address>
Assessor Number:	TEST000000
Accreditation scheme:	EPCgen.NET test AS
Related Party Disclosure:	Not related to the owner

ONLY FOR ILLUSTRATION

(*) Unless superseded by a later recommendation report

Page 1 of 8

This is not a valid certificate

Table of Contents

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2. Introduction..... 3

3. Recommendations..... 4

4. Next Steps..... 6

5. Glossary..... 8

This is not a valid certificate

1. Background

Statutory Instrument 2007 No. 991, *The Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007*, as amended, transposes the requirements of Articles 7.2 and 7.3 of the Energy Performance of Buildings Directive 2002/91/EC.

This report is a Recommendation Report as required under regulations 16(2)(a) and 19 of the Statutory Instrument SI 2007:991.

This section provides general information regarding the building:

Total Useful Floor Area (m^2):	2900
Building Environment:	Air Conditioning

2. Introduction

This Recommendation Report was produced in line with the Government's approved methodology and is based on calculation tool iSBEM v3.4.b using calculation engine SBEM v3.4.b .

In accordance with Government's current guidance, the Energy Assessor did undertake a walk around survey of the building prior to producing this Recommendation Report.

This is not a valid certificate

3. Recommendations

The following sections list recommendations selected by the energy assessor for the improvement of the energy performance of the building. The recommendations are listed under four headings: short payback, medium payback, long payback, and other measures.

a) Recommendations with a short payback

This section lists recommendations with a payback of less than 3 years:

Recommendation	Potential impact
Consider replacing T8 lamps with retrofit T5 conversion kit.	HIGH
The default chiller efficiency is chosen. It is recommended that the chiller system be investigated to gain an understanding of its efficiency and possible improvements.	LOW
Introduce HF (high frequency) ballasts for fluorescent tubes: Reduced number of fittings required.	LOW
Some spaces have a significant risk of overheating. Consider solar control measures such as the application of reflective coating or shading devices to windows.	MEDIUM

b) Recommendations with a medium payback

This section lists recommendations with a payback of between 3 and 7 years:

Recommendation	Potential impact
Add time control to heating system.	LOW
Add optimum start/stop to the heating system.	LOW
The default heat generator efficiency is chosen. It is recommended that the heat generator system be investigated to gain an understanding of its efficiency and possible improvements.	LOW
Some walls have uninsulated cavities - introduce cavity wall insulation.	LOW

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c) Recommendations with a long payback

This section lists recommendations with a payback of more than 7 years:

Recommendation	Potential impact
Add local temperature control to the heating system.	LOW
Add weather compensation controls to heating system.	LOW
Add local time control to heating system.	LOW
Consider installing building mounted wind turbine(s).	LOW
Consider installing solar water heating.	LOW

d) Other recommendations

This section lists other recommendations selected by the energy assessor, based on an understanding of the building, and / or based on a valid existing energy report.

No recommendations defined by the energy assessor have been identified

This is not a valid certificate
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This is not a valid certificate

4. Next steps

a) Your Recommendation Report

As the building occupier, regulation 10(1) of SI 2007:991 requires that an Energy Performance Certificate *"must be accompanied by a recommendation report"*.

You must be able to produce a copy of this Recommendation Report within seven days if requested by an Enforcement Authority under regulation 39 of SI 2007:991.

This Recommendation Report has also been lodged on the Government's central register. Access to the report, to the data used to compile the report, and to previous similar documents relating to the same building can be obtained by request through the Non-Dwellings Register (www.epcregister.com) using the report reference number of this document.

b) Implementing recommendations

The recommendations are provided as an indication of opportunities that appear to exist to improve the building's energy efficiency.

The calculation tool has automatically produced a set of recommendations, which the Energy Assessor has reviewed in the light of his / her knowledge of the building and its use. The Energy Assessor may have comments on the recommendations based on his / her knowledge of the building and its use. The Energy Assessor may have inserted additional measures in section 3d (Other Recommendations). He / she may have removed some automatically generated recommendations or added additional recommendations.

These recommendations do not include matters relating to operation and maintenance which cannot be identified from the calculation procedure.

This is not a valid certificate

c) Legal disclaimer

The advice provided in this Recommendation Report is intended to be for information only. Recipients of this Recommendation Report are advised to seek further detailed professional advice before reaching any decision on how to improve the energy performance of the building.

d) Complaints

Details of the assessor and the relevant accreditation scheme are on this report and the energy performance certificate. You can get contact details of the accreditation scheme from our website at www.communities.gov.uk/epbd, together with details of their procedures for confirming authenticity of a certificate and for making a complaint.

This is not a valid certificate

5. Glossary

a) Payback

The payback periods are based on data provided by Good Practice Guides and Carbon Trust energy survey reports and are average figures calculated using a simple payback method. It is assumed that the source data is correct and accurate using up to date information.

The figures have been calculated as an average across a range of buildings and may differ from the actual payback period for the building being assessed. Therefore, it is recommended that each suggested measure be further investigated before reaching any decision on how to improve the energy efficiency of the building.

b) Carbon impact

The High / Medium / Low carbon impact indicators against each recommendation are provided to distinguish, between the suggested recommendations, those that would have most impact on carbon emissions from the building. For automatically generated recommendations, the carbon impact indicators are determined by software, but may have been adjusted by the Energy Assessor based on his / her knowledge of the building. The impact of other recommendations are determined by the assessor.

c) Valid report

A valid report is a report that has been:

- Produced within the past 10 years
- Produced by an Energy Assessor who is accredited to produce Recommendation Reports through a Government Approved Accreditation Scheme
- Lodged on the Register operated by or on behalf of the Secretary of State.

A.8. Sample SBEM Secondary Recommendations Report

Secondary Recommendations Report

Not for Official Submission

Building name

Example building

Building type: Office **Date:** Tue Jan 26 16:03:24 2010

This report lists recommendations for energy-efficiency improvements to the building.

Key to colour codes used in this report

Included by the calculation
Included by the user
Excluded by the user

Recommendations for HEATING

HEATING accounts for 9.2% of the CO2 emissions
(If hot water is provided by the HVAC system, then the % of CO2 emissions includes hot water provision)
The overall energy performance of HEATING provision is GOOD
The overall CO2 performance of HEATING provision is GOOD
The average energy efficiency of HEATING provision is GOOD
The average CO2 efficiency of HEATING provision is GOOD

Add time control to heating system.

Code:	EPC-H2
Energy Impact:	LOW
CO2 Impact:	LOW
CO2 Saved per £ Spent:	FAIR
Applicable to:	Whole building

Comments:

Add local time control to heating system.

Code:	EPC-H5
Energy Impact:	LOW
CO2 Impact:	LOW
CO2 Saved per £ Spent:	POOR
Applicable to:	Whole building

Comments:

Add local temperature control to the heating system.

Code:	EPC-H6
Energy Impact:	LOW
CO2 Impact:	LOW
CO2 Saved per £ Spent:	POOR
Applicable to:	Whole building

Comments:

Add optimum start/stop to the heating system.

Code:	EPC-H7
Energy Impact:	LOW

ONLY FOR ILLUSTRATION

CO2 Impact: LOW
CO2 Saved per £ Spent: FAIR
Applicable to: Whole building

Comments:

Add weather compensation controls to heating system.

Code: EPC-H8
Energy Impact: LOW
CO2 Impact: LOW
CO2 Saved per £ Spent: POOR
Applicable to: Whole building

Comments:

The default heat generator efficiency is chosen. It is recommended that the heat generator system be investigated to gain an understanding of its efficiency and possible improvements.

Code: EPC-H4
Energy Impact: LOW
CO2 Impact: LOW
CO2 Saved per £ Spent: POOR
Applicable to: Whole building

Comments:

The default heat generator efficiency is chosen. It is recommended that the heat generator system be investigated to gain an understanding of its efficiency and possible improvements.

Code: EPC-H4
Energy Impact: LOW
CO2 Impact: LOW
CO2 Saved per £ Spent: POOR
Applicable to: HVAC for the example building

Comments:

Add time control to heating system.

Code: EPC-H2
Energy Impact: LOW
CO2 Impact: LOW
CO2 Saved per £ Spent: FAIR
Applicable to: HVAC for the example building

Comments:

Add local time control to heating system.

Code: EPC-H5
Energy Impact: LOW
CO2 Impact: LOW
CO2 Saved per £ Spent: POOR
Applicable to: HVAC for the example building

Comments:

Add local temperature control to the heating system.

Code: EPC-H6
Energy Impact: LOW
CO2 Impact: LOW
CO2 Saved per £ Spent: POOR
Applicable to: HVAC for the example building

Comments:

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Add optimum start/stop to the heating system.

Code:	EPC-H7
Energy Impact:	LOW
CO2 Impact:	LOW
CO2 Saved per £ Spent:	FAIR
Applicable to:	HVAC for the example building

Comments:

Add weather compensation controls to heating system.

Code:	EPC-H8
Energy Impact:	LOW
CO2 Impact:	LOW
CO2 Saved per £ Spent:	POOR
Applicable to:	HVAC for the example building

Comments:

Recommendations for COOLING

COOLING accounts for 30.8% of the CO2 emissions
The overall energy performance of COOLING provision is GOOD
The overall CO2 performance of COOLING provision is GOOD
The average energy efficiency of COOLING provision is GOOD
The average CO2 efficiency of COOLING provision is GOOD

The default chiller efficiency is chosen. It is recommended that the chiller system be investigated to gain an understanding of its efficiency and possible improvements.

Code:	EPC-C1
Energy Impact:	LOW
CO2 Impact:	LOW
CO2 Saved per £ Spent:	GOOD
Applicable to:	Whole building

Comments:

The default chiller efficiency is chosen. It is recommended that the chiller system be investigated to gain an understanding of its efficiency and possible improvements.

Code:	EPC-C1
Energy Impact:	LOW
CO2 Impact:	LOW
CO2 Saved per £ Spent:	GOOD
Applicable to:	HVAC for the example building

Comments:

Recommendations for HOT-WATER

HOT-WATER accounts for 0% of the CO2 emissions
(If hot water is provided by the HVAC system, then hot water provision is included in the % of CO2 emissions due to HEATING)
The overall energy performance of HOT-WATER provision is GOOD
The overall CO2 performance of HOT-WATER provision is GOOD
The average energy efficiency of HOT-WATER provision is NOT APPLICABLE
The average CO2 efficiency of HOT-WATER provision is NOT APPLICABLE

ONLY FOR ILLUSTRATION

There are no recommendations for HOT-WATER

Recommendations for LIGHTING

LIGHTING accounts for 42.2% of the CO2 emissions
The overall energy performance of LIGHTING provision is GOOD
The overall CO2 performance of LIGHTING provision is GOOD

Consider replacing T8 lamps with retrofit T5 conversion kit.

Code:	EPC-L5
Energy Impact:	MEDIUM
CO2 Impact:	HIGH
CO2 Saved per £ Spent:	GOOD
Applicable to:	Whole building

Comments:

Introduce HF (high frequency) ballasts for fluorescent tubes: Reduced number of fittings required.

Code:	EPC-L7
Energy Impact:	LOW
CO2 Impact:	LOW
CO2 Saved per £ Spent:	GOOD
Applicable to:	Whole building

Comments:

Recommendations for RENEWABLES

Consider installing building mounted wind turbine(s).

Code:	EPC-R2
Energy Impact:	LOW
CO2 Impact:	LOW
CO2 Saved per £ Spent:	POOR
Applicable to:	Whole building

Comments:

Consider installing solar water heating.

Code:	EPC-R3
Energy Impact:	LOW
CO2 Impact:	LOW
CO2 Saved per £ Spent:	POOR
Applicable to:	Whole building

Comments:

Consider installing PV.

Code:	EPC-R4
Energy Impact:	LOW
CO2 Impact:	LOW
CO2 Saved per £ Spent:	POOR
Applicable to:	Whole building

Comments:

ONLY FOR ILLUSTRATION

Recommendations for OVERHEATING

The risk of some spaces in the building OVERHEATING is Moderate risk

Some spaces have a significant risk of overheating. Consider solar control measures such as the application of reflective coating or shading devices to windows.

Code:	EPC-V1
Energy Impact:	MEDIUM
CO2 Impact:	MEDIUM
CO2 Saved per £ Spent:	POOR
Applicable to:	Whole building

Comments:

Recommendations for ENVELOPE

Some walls have uninsulated cavities - introduce cavity wall insulation.

Code:	EPC-E4
Energy Impact:	LOW
CO2 Impact:	LOW
CO2 Saved per £ Spent:	POOR
Applicable to:	Whole building

Comments:

Recommendations for FUEL-SWITCHING

Consider switching from gas to biomass.

Code:	EPC-F5
Energy Impact:	LOW
CO2 Impact:	HIGH
CO2 Saved per £ Spent:	GOOD
Applicable to:	HVAC for the example building

Comments:

Recommendations for AUXILIARY

AUXILIARY accounts for 17.8% of the CO2 emissions
The overall energy performance of AUXILIARY provision is FAIR
The overall CO2 performance of AUXILIARY provision is FAIR

There are no recommendations for AUXILIARY

Recommendations for OTHER

ONLY FOR ILLUSTRATION

There are no recommendations for OTHER

ONLY FOR ILLUSTRATION

A.9. Sample SBEM BRUKL Output Document

BRUKL Output Document

HM Government

Compliance with England and Wales Building Regulations Part L

Project name

Example building

As built

Date: Fri Jun 04 11:26:59 2010

Administrative information

Building Details

Address: 56 London Road, LONDON, SW23 1HA

Certification tool

Calculation engine: SBEM

Calculation engine version: v3.5.a.0

Interface to calculation engine: iSBEM

Interface to calculation engine version: v3.5.a

BRUKL compliance check version: v3.5.a.0

Owner Details

Name: John Jones

Telephone number: 987654321

Address: 53 London Road, LONDON, SW23 1HA

Certifier details

Name: <ea name>

Telephone number: <ea phone>

Address: <ea address>, <ea city>, XXXX XX

Criterion 1: Predicted CO2 emission from proposed building does not exceed the target

The building does not comply with England and Wales Building Regulations Part L

1.1	Calculated CO2 emission rate from notional building	115 KgCO2/m2.annum
1.2	Improvement factor	0.2
1.3	LZC benchmark	0.1
1.4	Target CO2 Emission Rate (TER)	82.8 KgCO2/m2.annum
1.5	Building CO2 Emission Rate (BER)	87.7 KgCO2/m2.annum
1.6	Are emissions from building less than or equal to the target?	BER > TER
1.7	Are as built details the same as used in BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services systems should be no worse than the design limits

2.1 Are the U-values better than the design limits? Better than design limits

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Limit}$	$U_{i\text{-}Calc}$	Surface where this maximum value occurs*
Wall**	0.35	0.24	0.7	0.24	z0/01east/e
Floor	0.25	0.12	0.7	0.25	z1/01centre/fe
Roof	0.25	0.25	0.35	0.25	z1/01centre/c
Windows***, roof windows, and rooflights	2.2	2.1	3.3	2.1	z0/01north/n/g
Personnel doors	2.2	2	3	2	z0/03/w/d
Vehicle access & similar large doors	1.5	0	4	0	"No heat loss vehicle access doors"
High usage entrance doors	6	0	6	0	"No heat loss high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m2K)] $U_{i\text{-}Limit}$ = Limiting individual element U-values [W/(m2K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m2K)] $U_{i\text{-}Calc}$ = Calculated individual element U-values [W/(m2K)]

* There might be more than one surface exceeding the limiting standards.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standards are similar to those for windows.

*** Display windows and similar glazing are not required to meet the standard given in this table.

2.2 Is air permeability no greater than the worst acceptable standard? No greater than worst acceptable standard

Air Permeability	Worst acceptable standard	This building (Design value)
m3/(h.m2) at 50 Pa	10	8

2.3 Are all building services standards acceptable?

2.3a-1 HVAC for the example building HVAC system standard is acceptable

Efficiency check	Limiting heat source seasonal efficiency	This building
Heat source efficiency	0.84	0.89
0.84 is the overall limiting efficiency for a single or a multiple boiler system. For a multiple boiler system the limiting efficiency for any individual boiler is 0.80.		
Efficiency check	**Limiting Cooling Nominal efficiency**	**This building**
Cooling efficiency	2.25	3.12
Efficiency check	**Limiting Specific Fan Power**	**This building**
SFP	2.5	2.2

2.3b- "No HWS in project, or hot water is provided by HVAC system"

2.4	Does fixed internal lighting comply with England and Wales Building Regulations Part L paragraphs 49 to 61?	Separate submission
2.5	Are energy meters installed in accordance with GIL65?	Separate submission

Criterion 3: The spaces in the building without air-conditioning have appropriate passive control measures to limit the effects of solar gains

3.1	Method of showing compliance with England and Wales Building Regulations Part L in paragraph 64?	Separate submission

Criterion 4: The performance of the building, as built, is consistent with the BER

4.1	Have the key features of the design been included (or bettered) in practice?	Separate submission
4.2	Is the level of thermal bridging acceptable?	Separate submission
4.3	Has satisfactory documentary evidence of site inspection checks been produced?	Separate submission

4.4 Design air permeability

Air Permeability	Worst acceptable standard	This building (Design value)
m3/(h.m2) at 50 Pa	10	8

4.5	Has evidence been provided that demonstrates that the design air permeability has been achieved satisfactorily?	Separate submission
4.6	Has commissioning been completed satisfactorily?	Separate submission
4.7	Has evidence been provided that demonstrates that the ductwork is sufficiently airtight?	Separate submission

Criterion 5: Providing information

5.1	Has a suitable building log-book been prepared?	Separate submission

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area (m2)	2900	2900
External area (m2)	4308	4308
Weather	LON	LON
Infiltration (m3/hm2 @ 50Pa)	8	10
Average conductance (W/K)	1373.62	2646.55
Average U-value (W/m2K)	0.32	0.61
Alpha value (%)	5.96	10

Building Use

% area	Building Type
53	**Office**
	Primary school
	Secondary school
	Further education universities
	Primary health care buildings
	Nursing residential homes and hostels
	Hospital
	Hotel
16	**Restaurant/public house**
	Sports centre/leisure centre
	Sports ground arena
31	**Retail**
	Warehouse and storage
	Theatres/cinemas/music halls and auditoria
	Social clubs
	Community/day centre
	Libraries/museums/galleries
	Prisons
	Emergency services
	Crown and county courts
	Airport terminals
	Bus station/train station/seaport terminal
	Workshops/maintenance depot
	Telephone exchanges
	Industrial process building
	Launderette
	Dwelling
	Retail warehouses
	Miscellaneous 24hr activities

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling, [HS] LTHW boiler, [HFT] Oil, [CFT] Grid Supplied Electricity										
	Actual	0	5.7	0	0	4.6	0	0	0	0
	Notional	0	172.4	0	0	1.5	0	0	----	----
[ST] Single-duct VAV, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Grid Supplied Electricity										
	Actual	45.9	427.5	15.8	66.8	38.5	0.81	1.78	0.89	2.5
	Notional	143.9	555.7	48.1	92.4	34.5	0.83	1.67	----	----

Key to terms

Alpha value (%)	= percentage of the building's average heat transfer coefficient which is due to thermal bridging
Heat dem (MJ/m2)	= Heating energy demand
Cool dem (MJ/m2)	= Cooling energy demand
Heat con (kWh/m2)	= Heating energy consumption
Cool con (kWh/m2)	= Cooling energy consumption
Aux con (kWh/m2)	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

A.10. Sample Energy Performance Certificate for Scotland

Energy Performance Certificate for buildings other than dwellings

Energy Performance Certificate

Building Energy Performance — **Scotland**

Calculated asset rating using iSBEM v3.4.b [SBEM]	Building type Office	Current rating
		Excellent
	Carbon Neutral	
	A (0 to 15)	
	B (16 to 30)	
	C (31 to 45)	
	D (46 to 60)	
	E (61 to 80)	
	F (81 to 100)	F+
	G (100+)	
		Very Poor

Carbon Dioxide Emissions The number refers to the calculated carbon dioxide emissions in terms of kg per m^2 of floor area per year	88
Approximate current energy use per m^2 of floor area:	236 kWh/m^2

Main heating fuel: Natural Gas — **Building Services:** Air conditioning

Renewable energy source: — **Electricity:** Grid supplied

Carbon Dioxide is a greenhouse gas which contributes to climate change. Less Carbon Dioxide emissions from buildings helps the environment.

Benchmarks

A building of this type built to building regulations standards current at the date of issue of this certificate would have a rating: 83	F+
Where the accompanying recommendations for the cost effective improvement of energy performance are applied, this building would have a rating: 61	E+

Recommendations for the cost-effective improvement (lower cost measures) of the energy performance

1. Consider replacing T8 lamps with retrofit T5 conversion kit.
2. The default chiller efficiency is chosen. It is recommended that the chiller system be investigated to gain an understanding of its efficiency and possible improvements.
3. Introduce HF (high frequency) ballasts for fluorescent tubes: Reduced number of fittings required.
4. Some spaces have a significant risk of overheating. Consider solar control measures such as the application of reflective coating or shading devices to windows.
5. Add time control to heating system.
6. Add optimum start/stop to the heating system.

Address: 56 London Road, LONDON, SW23 1HA
Conditioned area (m^2): 2900
Name of protocol organisation: Not accredited, [00000034555]
Date of issue of certificate: 26 Jan 2010 (Valid for a period not exceeding 10 years)

This certificate is a requirement of EU Directive 2002/91/EC on the energy performance of buildings.

NB THIS CERTIFICATE MUST BE AFFIXED TO THE BUILDING AND NOT REMOVED UNLESS REPLACED WITH AN UPDATED VERSION AND FOR PUBLIC BUILDINGS DISPLAYED IN A PROMINENT PLACE

A.11. Sample Specification Information Document for Scottish Building Regulations

SBEM Specification Information

Scottish Building Regulations Section 6 Guidance
Carbon Dioxide Emissions, U-Values, Air Permeability, and HVAC

Project name

Example building

Date: Tue Jan 26 16:23:31 2010

Administrative information

Building Details

Address: 56 London Road, LONDON, SW23 1HA

Certification tool

Calculation engine: SBEM

Calculation engine version: v3.4.b

Interface to calculation engine: iSBEM

Interface to calculation engine version: v3.4.b

Compliance check version: v3.4.b

Owner Details

Name: John Jones

Telephone number: 987654321

Address: 53 London Road, LONDON, SW23 1HA

Agent details

Name: <ea name>

Telephone number: <ea phone>

Address: <ea address>, <ea city>, XXXX XX

1- Predicted CO2 emission from proposed building

1.1	Calculated CO2 emission rate from notional building	115.7 KgCO2/m2.annum
1.2	Improvement factor	0.2
1.3	LZC benchmark	0.1
1.4	Target CO2 Emission Rate (TER)	83.3 KgCO2/m2.annum
1.5	Building CO2 Emission Rate (BER)	87.9 KgCO2/m2.annum
1.6	Are emissions from building less than or equal to the target?	BER > TER NO

2- The performance of the building fabric and the building services systems

2.1 How do the U-values compare with Section 6 guidance?

The building follows guidance in Scottish Building Regulations

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Limit}$	$U_{i\text{-}Calc}$	Surface where this maximum value occurs*
Wall	0.3***	0.24	0.7	0.24	z0/01east/e
Floor	0.25	0.12	0.7	0.25	z1/01centre/fe
Roof	0.25	0.25	0.35	0.25	z1/01centre/c
Windows**, roof windows, and rooflights	2.2	2.1	3.3	2.1	z0/01north/n/g
Personnel doors	2.2	2	3.3	2	z0/03/w/d
Vehicle access & similar large doors	1.5	0	1.5	0	"No heat loss vehicle access doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m2K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m2K)]
$U_{i\text{-}Limit}$ = Limiting individual element U-values [W/(m2K)]
$U_{i\text{-}Calc}$ = Calculated individual element U-values [W/(m2K)]

* There might be more than one surface exceeding the limiting standards.
** Display windows and similar glazing are not required to meet the standard given in this table.
*** 0.35 for modular and portable buildings.

2.2 Air permeability

Air Permeability	This building's value
m3/(h.m2) at 50 Pa	8

2.3 Are all building services standards acceptable?

2.3a-1 HVAC for the example building HVAC system standard is acceptable

Efficiency check	Limiting heat source seasonal efficiency	This building
Heat source efficiency	0.84	0.89
0.84 is the overall limiting efficiency for a single or a multiple boiler system. For a multiple boiler system the limiting efficiency for any individual boiler is 0.80.		
Efficiency check	**Limiting Cooling Nominal efficiency**	**This building**
Cooling efficiency	2.25	3.12
Efficiency check	**Limiting Specific Fan Power**	**This building**
SFP	2.5	2.2

2.3b- "No HWS in project, or hot water is provided by HVAC system"

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area (m2)	2900	2900
External area (m2)	4308	4308
Weather	GLA	GLA
Infiltration (m3/hm2 @ 50Pa)	8	10
Average conductance (W/K)	1373.62	2620.35
Average U-value (W/m2K)	0.32	0.61
Alpha value (%)	5.96	3.94

Building Use

% area	Building Type
53	**Office**
	Primary school
	Secondary school
	Further education universities
	Primary health care buildings
	Nursing residential homes and hostels
	Hospital
	Hotel
16	**Restaurant/public house**
	Sports centre/leisure centre
	Sports ground arena
31	**Retail**
	Warehouse and storage
	Theatres/cinemas/music halls and auditoria
	Social clubs
	Community/day centre
	Libraries/museums/galleries
	Prisons
	Emergency services
	Crown and county courts
	Airport terminals
	Bus station/train station/seaport terminal
	Workshops/maintenance depot
	Telephone exchanges
	Industrial process building
	Launderette
	Dwelling
	Retail warehouses
	Miscellaneous 24hr activities

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling, [HS] LTHW boiler, [HFT] Oil, [CFT] Grid Supplied Electricity										
	Actual	0	0.5	0	0	4.6	0	0	0	0
	Notional	0	124.3	0	0	1.5	0	0	----	----
[ST] Single-duct VAV, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Grid Supplied Electricity										
	Actual	76.5	399.9	26.3	62.5	38.5	0.81	1.78	0.89	2.5
	Notional	210.8	504.8	70.6	84	34.5	0.83	1.67	----	----

Key to terms

Alpha value (%)	= percentage of the building's average heat transfer coefficient which is due to thermal bridging
Heat dem (MJ/m2)	= Heating energy demand
Cool dem (MJ/m2)	= Cooling energy demand
Heat con (kWh/m2)	= Heating energy consumption
Cool con (kWh/m2)	= Cooling energy consumption
Aux con (kWh/m2)	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

APPENDIX B: iSBEM file conversion

If you want to open and edit files created with previous versions of iSBEM (version 1.0, 1.0.b, 1.1.a, 1.2.a_b01, 1.2.a, 2.0.b, 2.0.c, 2.9.b, 3.0.a, 3.0.b, 3.0.e, 3.0.f, 3.1.a, 3.2.b, 3.3.a, or 3.3.b) using this current version (v3.5.a), you will need to convert them first. The file conversion tool is downloaded and installed to your computer at the same time as you download and install the new version of iSBEM. There are 6 stages to converting the files:

1. **Open the file conversion tool** - Double-click on the 'nct_convert_3.5.a.mdb' file in the iSBEM_v3.5.a folder, as shown in Figure 97.

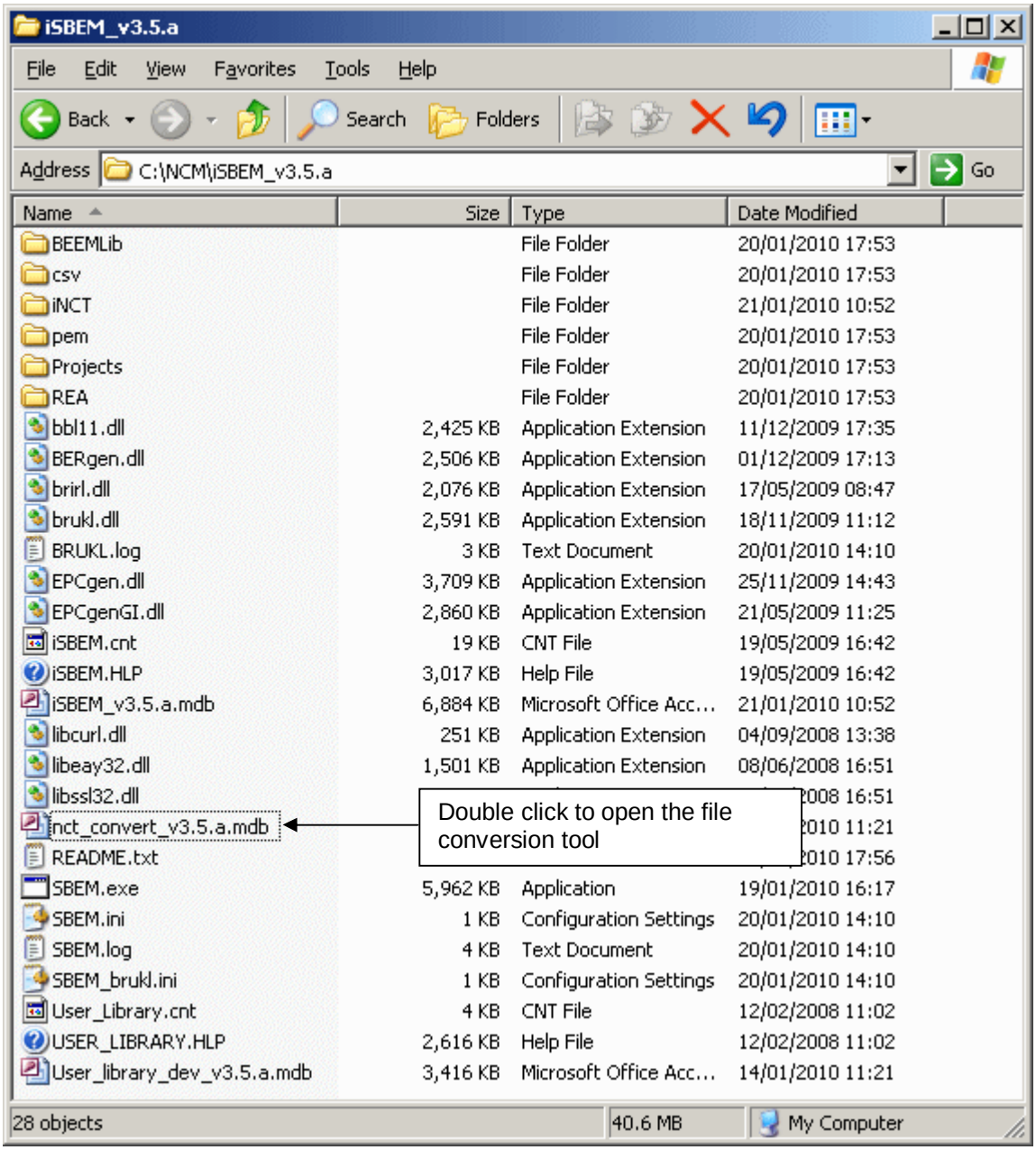

iSBEM_v3.5.a
File Edit View Favorites Tools Help
Back Search Folders
Address C:\NCM\iSBEM_v3.5.a
Go
Name Size Type Date Modified
BEEMLib File Folder 20/01/2010 17:53
csv File Folder 20/01/2010 17:53
iNCT File Folder 21/01/2010 10:52
pem File Folder 20/01/2010 17:53
Projects File Folder 20/01/2010 17:53
REA File Folder 20/01/2010 17:53
bbl11.dll 2,425 KB Application Extension 11/12/2009 17:35
BERgen.dll 2,506 KB Application Extension 01/12/2009 17:13
brirl.dll 2,076 KB Application Extension 17/05/2009 08:47
brukl.dll 2,591 KB Application Extension 18/11/2009 11:12
BRUKL.log 3 KB Text Document 20/01/2010 14:10
EPCgen.dll 3,709 KB Application Extension 25/11/2009 14:43
EPCgenGI.dll 2,860 KB Application Extension 21/05/2009 11:25
iSBEM.cnt 19 KB CNT File 19/05/2009 16:42
iSBEM.HLP 3,017 KB Help File 19/05/2009 16:42
iSBEM_v3.5.a.mdb 6,884 KB Microsoft Office Acc... 21/01/2010 10:52
libcurl.dll 251 KB Application Extension 04/09/2008 13:38
libeay32.dll 1,501 KB Application Extension 08/06/2008 16:51
libssl32.dll
nct_convert_v3.5.a.mdb
README.txt
SBEM.exe 5,962 KB Application 19/01/2010 16:17
SBEM.ini 1 KB Configuration Settings 20/01/2010 14:10
SBEM.log 4 KB Text Document 20/01/2010 14:10
SBEM_brukl.ini 1 KB Configuration Settings 20/01/2010 14:10
User_Library.cnt 4 KB CNT File 12/02/2008 11:02
USER_LIBRARY.HLP 2,616 KB Help File 12/02/2008 11:02
User_library_dev_v3.5.a.mdb 3,416 KB Microsoft Office Acc... 14/01/2010 11:21
Double click to open the file conversion tool
28 objects
40.6 MB
My Computer

Figure 97: Folder showing the file conversion tool

2. **Select the file you want to convert** - To do this, click on the button shown in Figure 98. This opens a dialogue box, shown in Figure 99, from which you need to browse to find the file you want to convert. Once you have found the file, click on 'Open'. (This file must have been created using either iSBEM_v1.0, v1.0.b, v1.1.a, v1.2.a_b01, 1.2.a, 2.0.b, 2.0.c, 2.9.b, 3.0.a, 3.0.b, 3.0.e, 3.1.a, or 3.2.b).

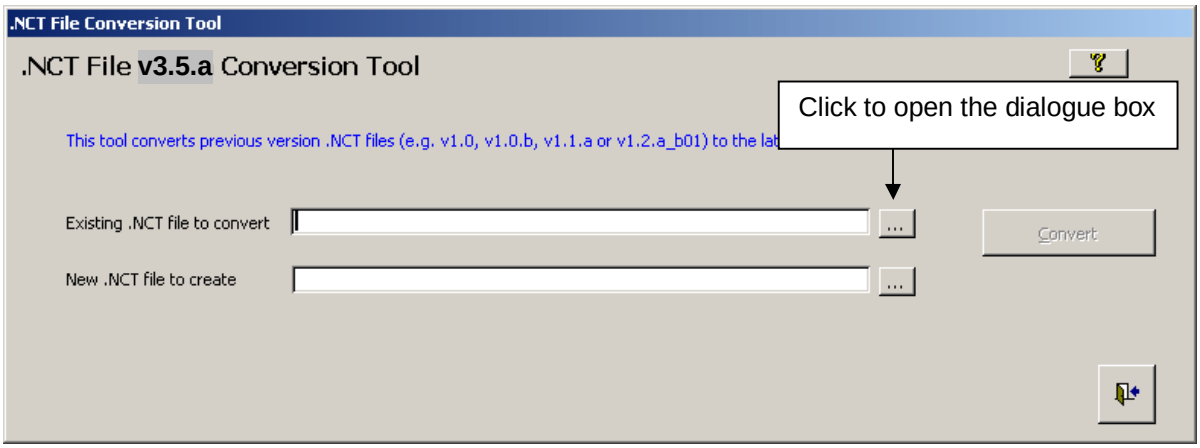

.NCT File Conversion Tool
.NCT File v3.5.a Conversion Tool
Click to open the dialogue box
This tool converts previous version .NCT files (e.g. v1.0, v1.0.b, v1.1.a or v1.2.a_b01) to the lat
Existing .NCT file to convert
New .NCT file to create
Convert

Figure 98: Selecting a file to convert - stage 1

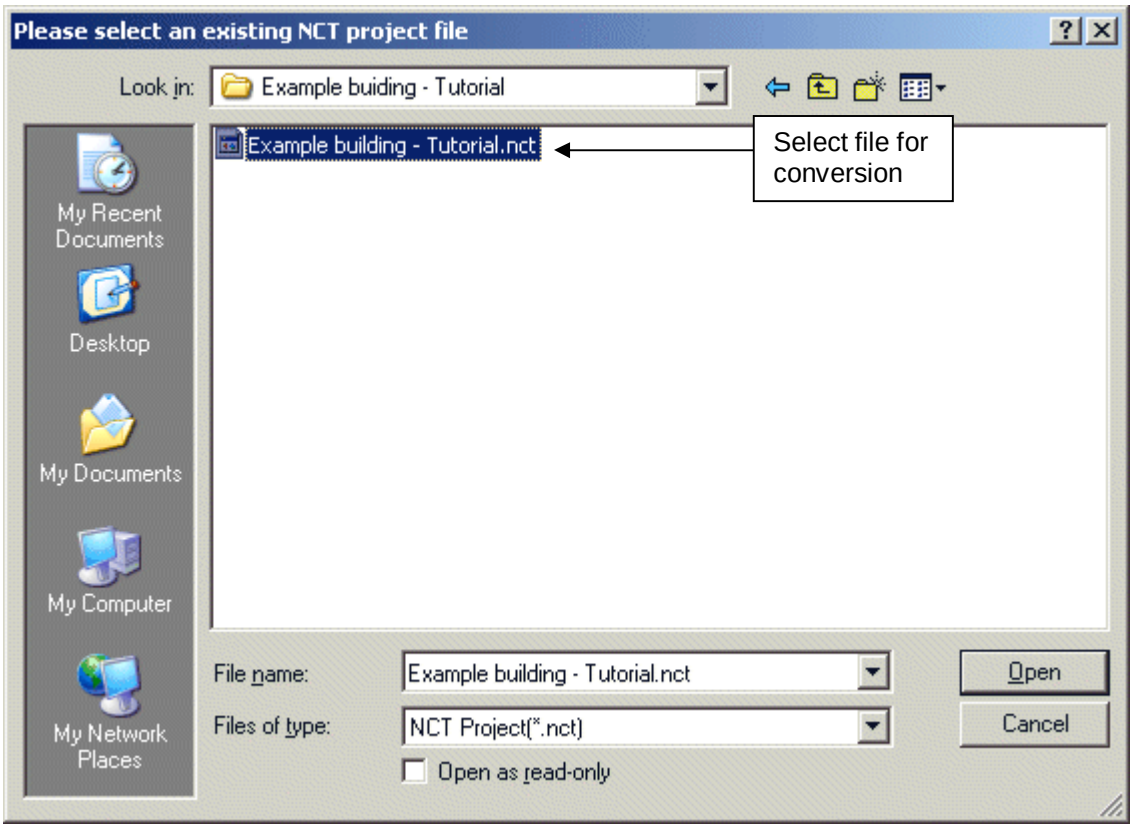


Figure 99: Selecting a file to convert - stage 2

3. **Choose a name for the converted file - There are two options:**

   i. Click on the button shown in Figure 100. This opens a dialogue box (the same as in stage 2). Re-select the file you are converting and click on 'Save'. The new file will automatically be given the name: "original file name_**v3.5.a.nct"**. The

original file will not be over-written by the conversion tool, and you should keep it for future reference.

ii. If you want to give the converted file a new name of your own, type a new name and its full path into the field (shown in Figure 100).

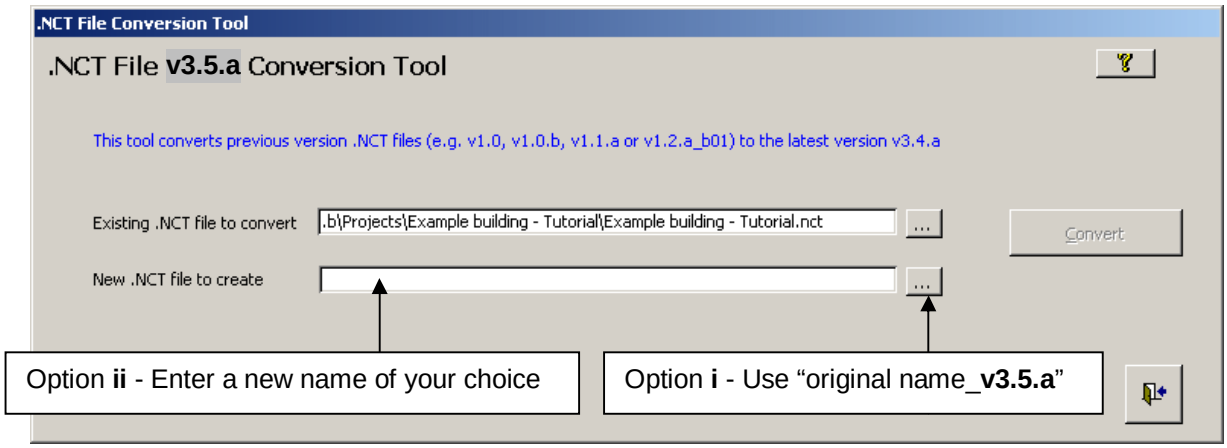

.NCT File Conversion Tool
.NCT File v3.5.a Conversion Tool
This tool converts previous version .NCT files (e.g. v1.0, v1.0.b, v1.1.a or v1.2.a_b01) to the latest version v3.4.a
Existing .NCT file to convert
.b\Projects\Example building - Tutorial\Example building - Tutorial.nct
Convert
New .NCT file to create
Option ii - Enter a new name of your choice
Option i - Use "original name_v3.5.a"

Figure 100: Naming the new file

4. **Convert the file** – When both of the fields are filled, the 'Convert' button becomes active (see Figure 101). Clicking on this button converts the files and produces the message shown in Figure 102. Click on 'OK'. The new file will be saved to the same folder as the original file by default, unless you specify otherwise.

5. **Close the tool** – Click on the 'Exit' button (see Figure 101).

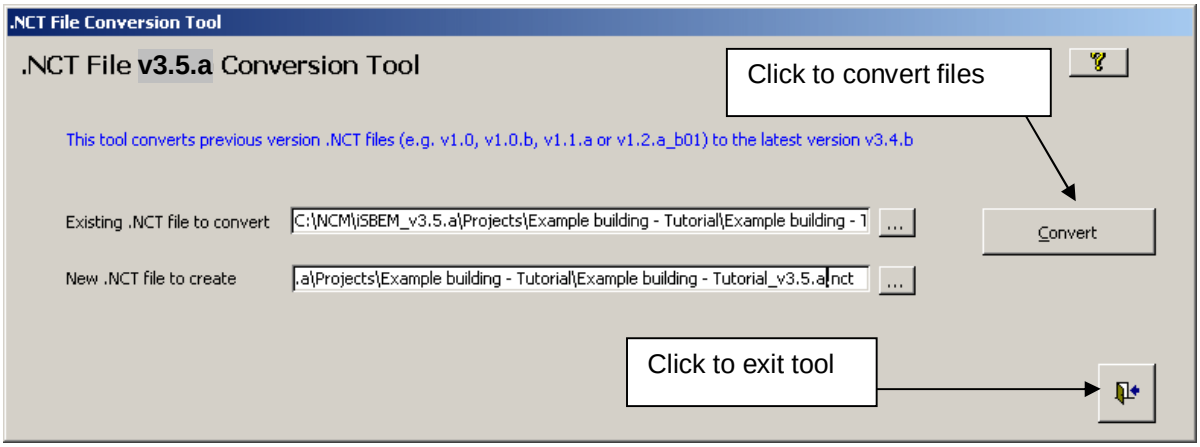

.NCT File Conversion Tool
.NCT File v3.5.a Conversion Tool
Click to convert files
This tool converts previous version .NCT files (e.g. v1.0, v1.0.b, v1.1.a or v1.2.a_b01) to the latest version v3.4.b
Existing .NCT file to convert
C:\NCM\iSBEM_v3.5.a\Projects\Example building - Tutorial\Example building - T
Convert
New .NCT file to create
.a\Projects\Example building - Tutorial\Example building - Tutorial_v3.5.a.nct
Click to exit tool

Figure 101: The Convert and Quit buttons

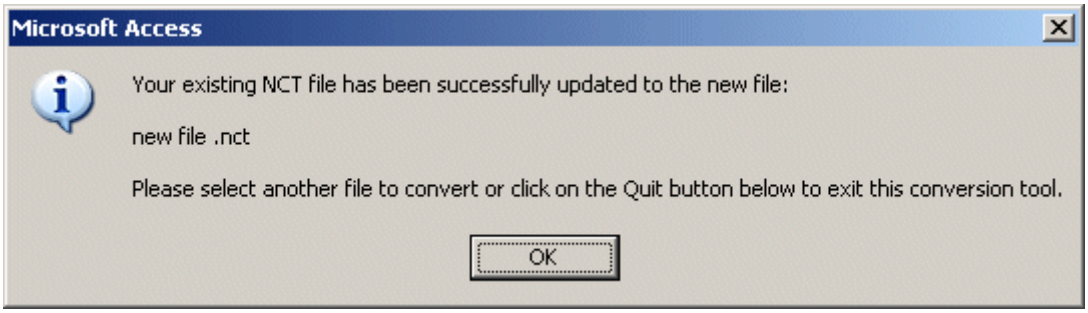

Microsoft Access
Your existing NCT file has been successfully updated to the new file:
new file .nct
Please select another file to convert or click on the Quit button below to exit this conversion tool.
OK

Figure 102: Message which appears after conversion

6. **Open iSBEM and open the newly created nct file** - Due to the nature of the changes introduced in the new version, some fields in some projects may not get refreshed automatically. In order to ensure all the fields in your project are refreshed and updated, after converting files generated by a previous version, you need to do the following (using the record navigation arrows at the bottom):
   - Click through all the envelope elements in the *Geometry* form > *Envelope* tab in order to refresh the adjacencies (i.e., the "connects space to" field).
   - Click through all the HVAC systems in the *Building Services* form > *HVAC systems* tab > *General* sub-tab.
   - Click through all the sub-tabs in the *Building Services* form > *Zones* tab.
   - Due to the construction database having been updated in certain parts, you may wish to review your construction definitions in the *Project Database* form if the constructions were selected either from the library or using the inference method.

7. **Double check and note the points which have changed since the previous version:**

Please see the front pages of this manual for a list of the changes introduced in this version of the tool and manual, as well as in each of the previous versions. It is essential that you click through and review **all** the different forms, tabs, and sub-tabs of iSBEM and ensure that you provide input for parameters that did not exist in previous versions. This would also allow any changes that have been made to iSBEM's default values to be adopted into the input correctly. You might also wish to modify your input for any of the existing parameters based on any further guidance added in this manual or the Help pages.

If you are converting a file from a version prior to v3.2.b, please note all the changes that have been introduced since your original version.

NB: The development of SBEM version 3.5.a has incorporated improvements to the calculation algorithms, added features, modifications to some of the underlying databases, and correction of identified minor bugs. Hence, the generated results may differ either way from those generated by previous versions, depending on the individual projects.

APPENDIX C: User-defined construction database

The User Library (User_library_3.5.a.mdb) is a feature first introduced with iSBEM_v2.0.c. You can now build up a database of your commonly used constructions so that you do not need to re-enter them each time you start a new project. You can also import constructions into your Library from a project you have been working on in iSBEM or from another User Library.

This appendix will take you through the basics of:

1. How to add a construction type to your library – and add this to iSBEM
2. How to add a glazing type to your library – and add this to iSBEM
3. How to add a frame type to your library – and add this to iSBEM
4. How to edit the list of opaque constructions categories and the list of sources
5. How to import constructions previously entered into an iSBEM project or in another User Library into your own User Library

For definitions of a particular parameter, place the curser in that field and press F1. This will open a window with the Help item for that field, in the same way that the Help can be accessed within iSBEM. These definitions are not included in this appendix.

The User library can be found as shown in Figure 103:

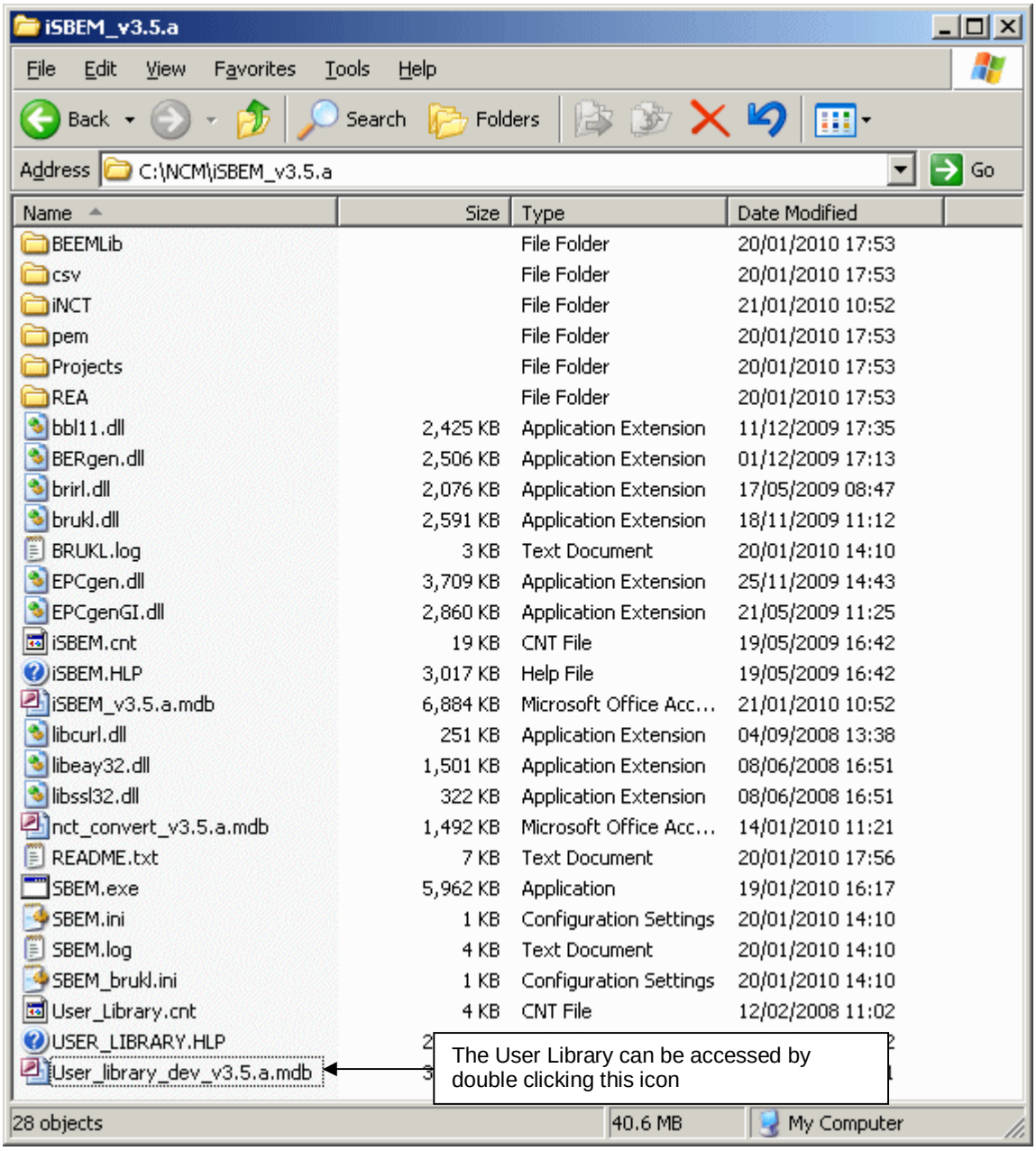

iSBEM_v3.5.a
File Edit View Favorites Tools Help
Back Search Folders
Address C:\NCM\iSBEM_v3.5.a
Go
Name Size Type Date Modified
BEEMLib File Folder 20/01/2010 17:53
csv File Folder 20/01/2010 17:53
iNCT File Folder 21/01/2010 10:52
pem File Folder 20/01/2010 17:53
Projects File Folder 20/01/2010 17:53
REA File Folder 20/01/2010 17:53
bbl11.dll 2,425 KB Application Extension 11/12/2009 17:35
BERgen.dll 2,506 KB Application Extension 01/12/2009 17:13
brirl.dll 2,076 KB Application Extension 17/05/2009 08:47
brukl.dll 2,591 KB Application Extension 18/11/2009 11:12
BRUKL.log 3 KB Text Document 20/01/2010 14:10
EPCgen.dll 3,709 KB Application Extension 25/11/2009 14:43
EPCgenGI.dll 2,860 KB Application Extension 21/05/2009 11:25
iSBEM.cnt 19 KB CNT File 19/05/2009 16:42
iSBEM.HLP 3,017 KB Help File 19/05/2009 16:42
iSBEM_v3.5.a.mdb 6,884 KB Microsoft Office Acc... 21/01/2010 10:52
libcurl.dll 251 KB Application Extension 04/09/2008 13:38
libeay32.dll 1,501 KB Application Extension 08/06/2008 16:51
libssl32.dll 322 KB Application Extension 08/06/2008 16:51
nct_convert_v3.5.a.mdb 1,492 KB Microsoft Office Acc... 14/01/2010 11:21
README.txt 7 KB Text Document 20/01/2010 17:56
SBEM.exe 5,962 KB Application 19/01/2010 16:17
SBEM.ini 1 KB Configuration Settings 20/01/2010 14:10
SBEM.log 4 KB Text Document 20/01/2010 14:10
SBEM_brukl.ini 1 KB Configuration Settings 20/01/2010 14:10
User_Library.cnt 4 KB CNT File 12/02/2008 11:02
USER_LIBRARY.HLP
User_library_dev_v3.5.a.mdb
The User Library can be accessed by double clicking this icon
28 objects
40.6 MB
My Computer

Figure 103: Location of the User-defined construction library

1. How to add a construction type to your library – and add this to iSBEM

To add a construction to the User Library, click into the *Constructions* form and follow the instructions starting by clicking on the “create new construction” button and finishing by updating the library in iSBEM.

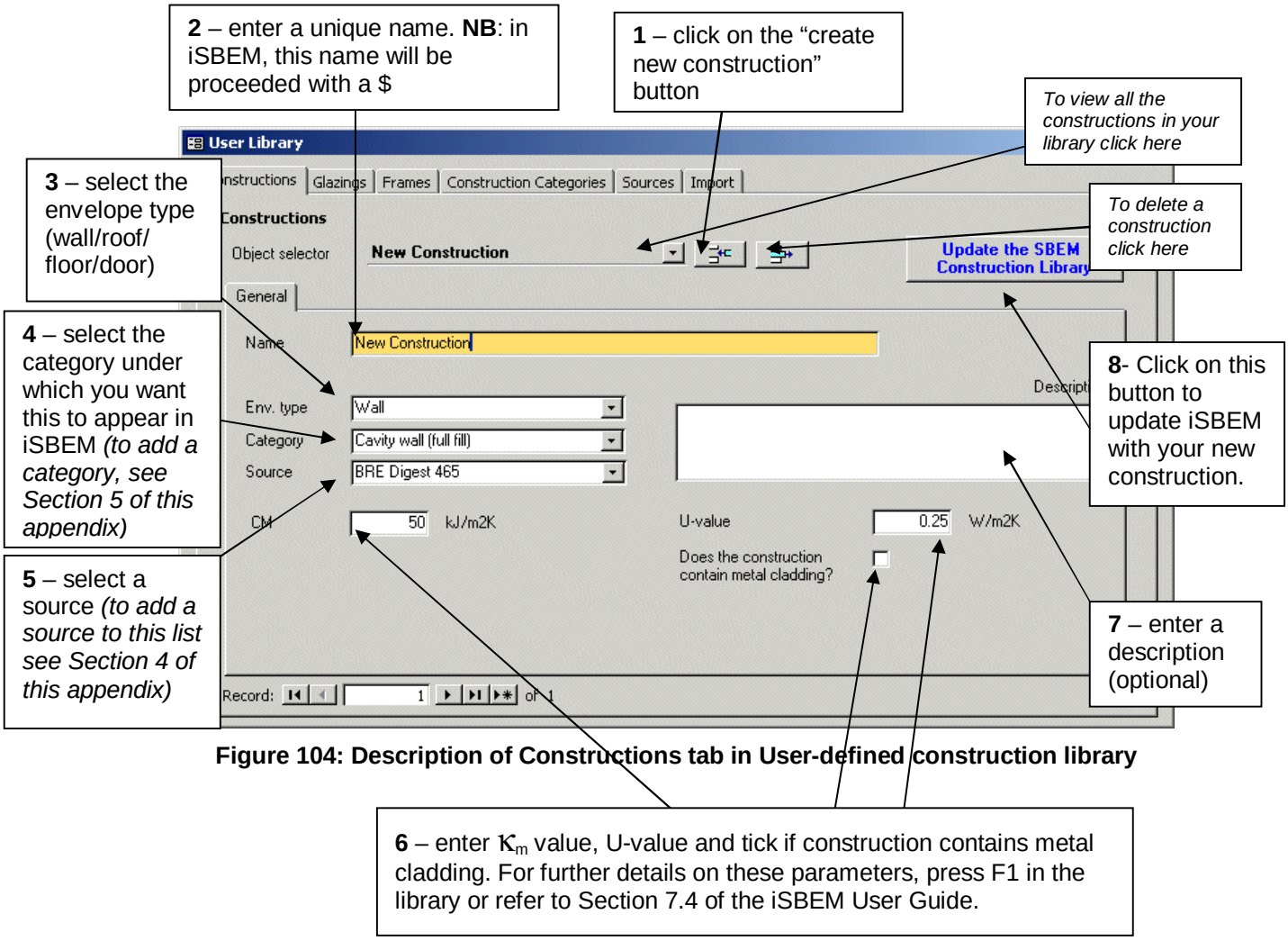

2 – enter a unique name. NB: in iSBEM, this name will be proceeded with a $
1 – click on the "create new construction" button
To view all the constructions in your library click here
To delete a construction click here
3 – select the envelope type (wall/roof/ floor/door)
4 – select the category under which you want this to appear in iSBEM (to add a category, see Section 5 of this appendix)
5 – select a source (to add a source to this list see Section 4 of this appendix)
8- Click on this button to update iSBEM with your new construction.
7 – enter a description (optional)
User Library
Glazings
Frames
Construction Categories
Sources
Import
Constructions
Object selector
New Construction
Update the SBEM Construction Library
General
Name
New Construction
Env. type
Wall
Category
Cavity wall (full fill)
Source
BRE Digest 465
CM
50
kJ/m2K
U-value
0.25
W/m2K
Does the construction contain metal cladding?
Record:
1
of 1

Figure 104: Description of Constructions tab in User-defined construction library

6 – enter κ_m value, U-value and tick if construction contains metal cladding. For further details on these parameters, press F1 in the library or refer to Section 7.4 of the iSBEM User Guide.

A construction created in this way will be accessible in iSBEM from the *Project Database* form. It will be located in the "Constructions for X" tab, where X is the type of envelope as selected in the envelope type field (stage 3) and under the category as selected in the category field (stage 4). The construction will be called $*Construction Name,* where *Construction Name* is the name entered in the name field.

2. How to add a glazing type to your library – and add this to iSBEM

Adding a new glazing type to the glazing Library and updating iSBEM with this information is done in the same way as for constructions but in the *Glazing* form. For glazing, in addition to requiring a unique name, U-value, and source of the information, you are required to enter parameters which describe the solar and light transmission properties of the glazing. For details of any of the parameters, press F1 or see Section 7.4 of the iSBEM User Guide.

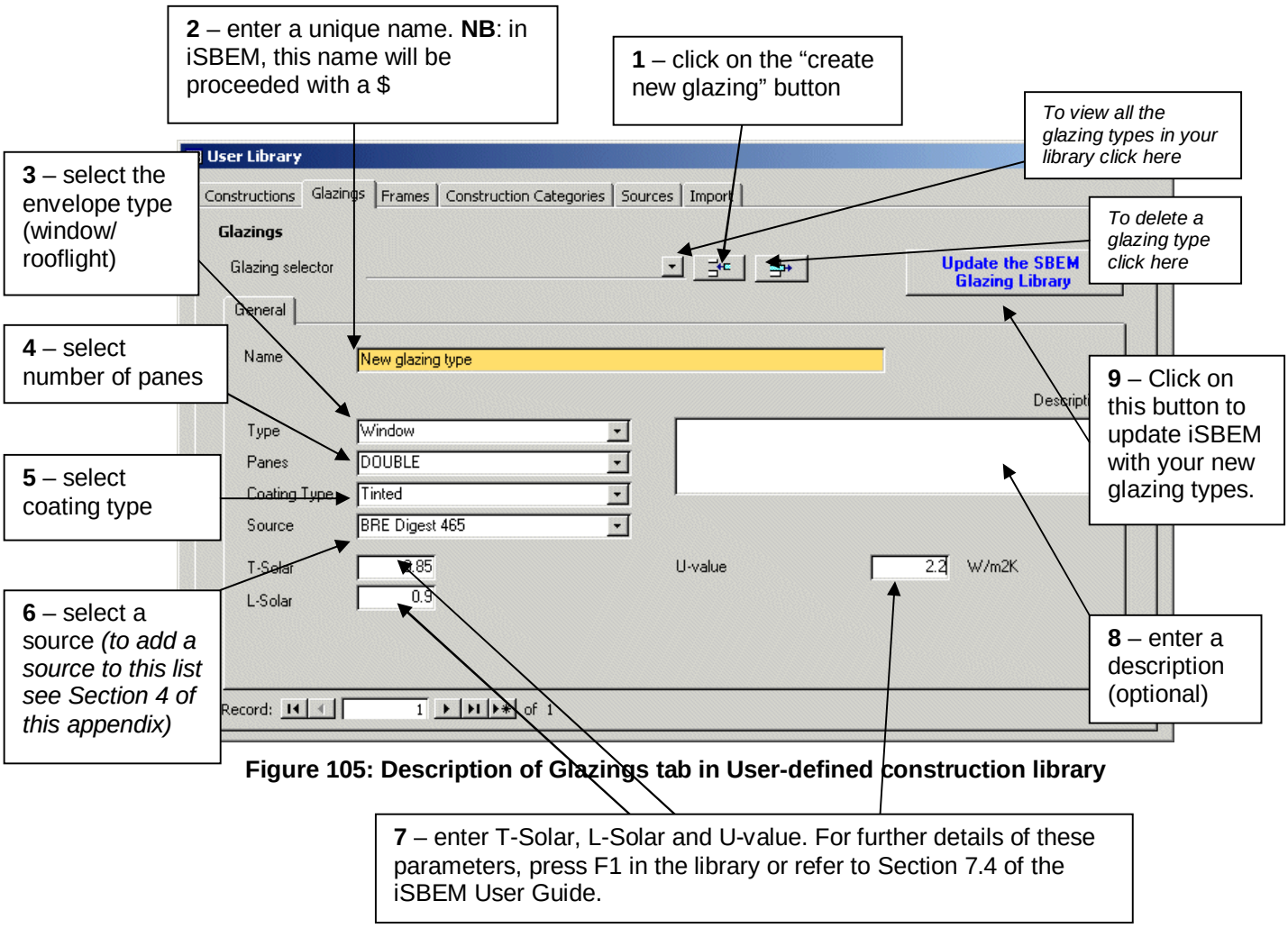

2 – enter a unique name. **NB**: in iSBEM, this name will be proceeded with a $
1 – click on the "create new glazing" button
To view all the glazing types in your library click here
To delete a glazing type click here
3 – select the envelope type (window/ rooflight)
4 – select number of panes
5 – select coating type
6 – select a source *(to add a source to this list see Section 4 of this appendix)*
9 – Click on this button to update iSBEM with your new glazing types.
8 – enter a description (optional)
User Library
Constructions
Glazings
Frames
Construction Categories
Sources
Import
Glazings
Glazing selector
Update the SBEM Glazing Library
General
Name
New glazing type
Type
Window
Panes
DOUBLE
Coating Type
Tinted
Source
BRE Digest 465
T-Solar
0.85
L-Solar
0.9
U-value
2.2
W/m2K
Record:
1
of 1
7 – enter T-Solar, L-Solar and U-value. For further details of these parameters, press F1 in the library or refer to Section 7.4 of the iSBEM User Guide.

Figure 105: Description of Glazings tab in User-defined construction library

A glazing type created in this way will be accessible in iSBEM in the *Project Database* form > *Glazing* tab. It will be accessible when the "import one from the library" radio button is selected, from the glazing library. The glazing type will be called $*Glazing Name,* where *Glazing Name* is the name entered in the name field.

3. How to add a frame type to your library – and add this to iSBEM

As with the glazing, you can add a frame to your frames library in the same way that you add a construction to the constructions library but in the *Frames* form. The only parameters required to define a frame is the type (PVC, hardwood, softwood, steel, etc.) and the U-value. You are able to enter a description as with the constructions and glazing libraries.

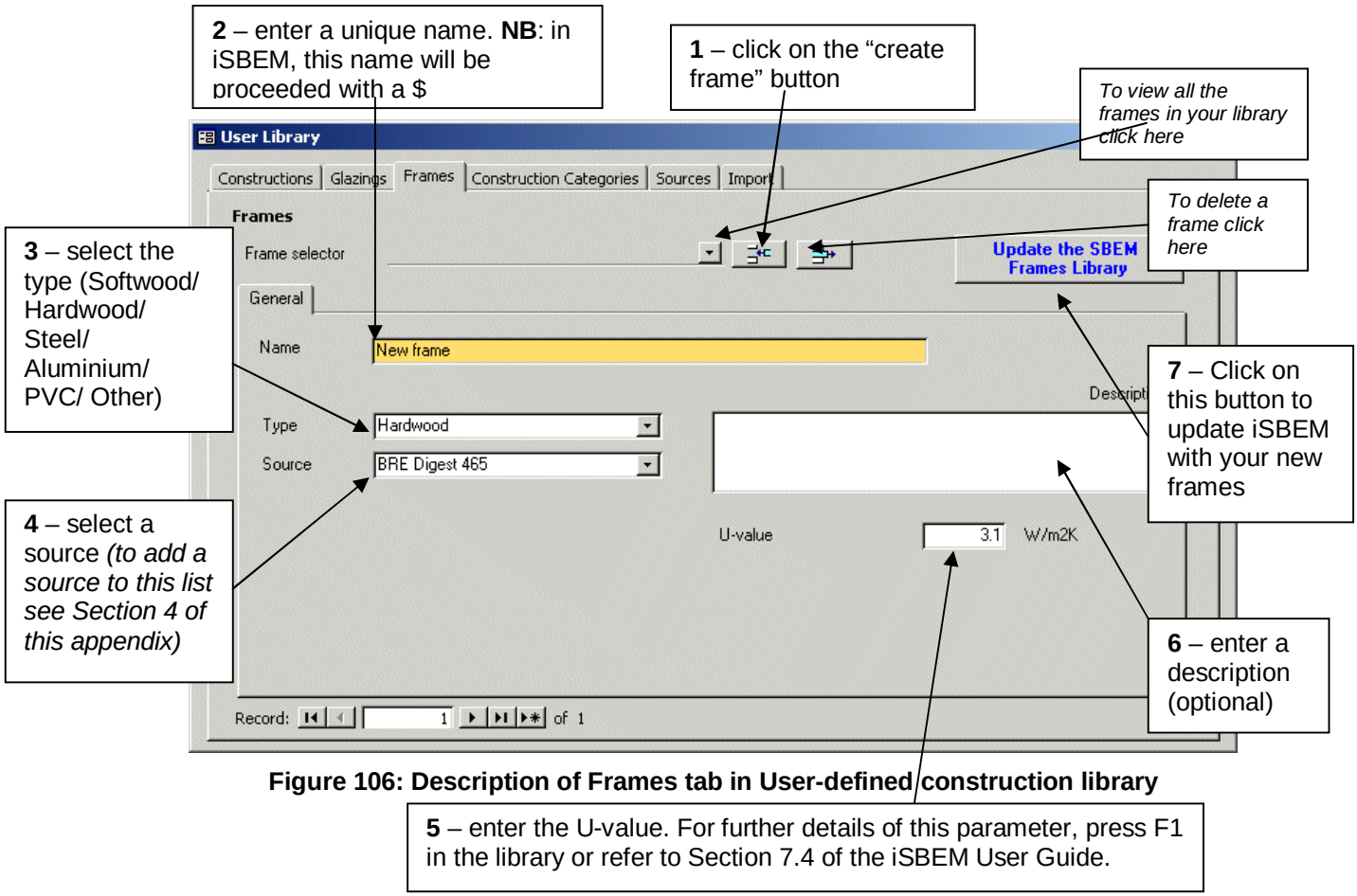

2 – enter a unique name. **NB**: in iSBEM, this name will be proceeded with a $
1 – click on the "create frame" button
To view all the frames in your library click here
To delete a frame click here
3 – select the type (Softwood/ Hardwood/ Steel/ Aluminium/ PVC/ Other)
7 – Click on this button to update iSBEM with your new frames
4 – select a source *(to add a source to this list see Section 4 of this appendix)*
6 – enter a description (optional)
User Library
Constructions
Glazings
Frames
Construction Categories
Sources
Import
Frames
Frame selector
Update the SBEM Frames Library
General
Name
New frame
Type
Hardwood
Source
BRE Digest 465
U-value
3.1
W/m2K
Record:
1
of 1

Figure 106: Description of Frames tab in User-defined construction library

5 – enter the U-value. For further details of this parameter, press F1 in the library or refer to Section 7.4 of the iSBEM User Guide.

A frame type created in this way will be accessible in iSBEM in the *Project Database* form > *Glazing* tab. It will be accessible when the "import one from the library" radio button is selected, from the frame library. The frame type will be called $*Frame Name,* where *Frame Name* is the name entered in the name field.

4. How to edit the list of opaque constructions categories and the list of Sources

- ***Editing the list of categories for opaque constructions***

  As described in Section 1, when creating a new construction type for your library, you need to select a category under which your construction will appear in iSBEM. If none of the pre-defined categories are appropriate, you can add a new one to the library in the *Category* form. To do this, enter the *Category* form, click on the "create new category" button, add a unique name in the name field, select an envelope type, and if you want, add a description. This category will now appear in the "Category" field in the *Constructions* form.

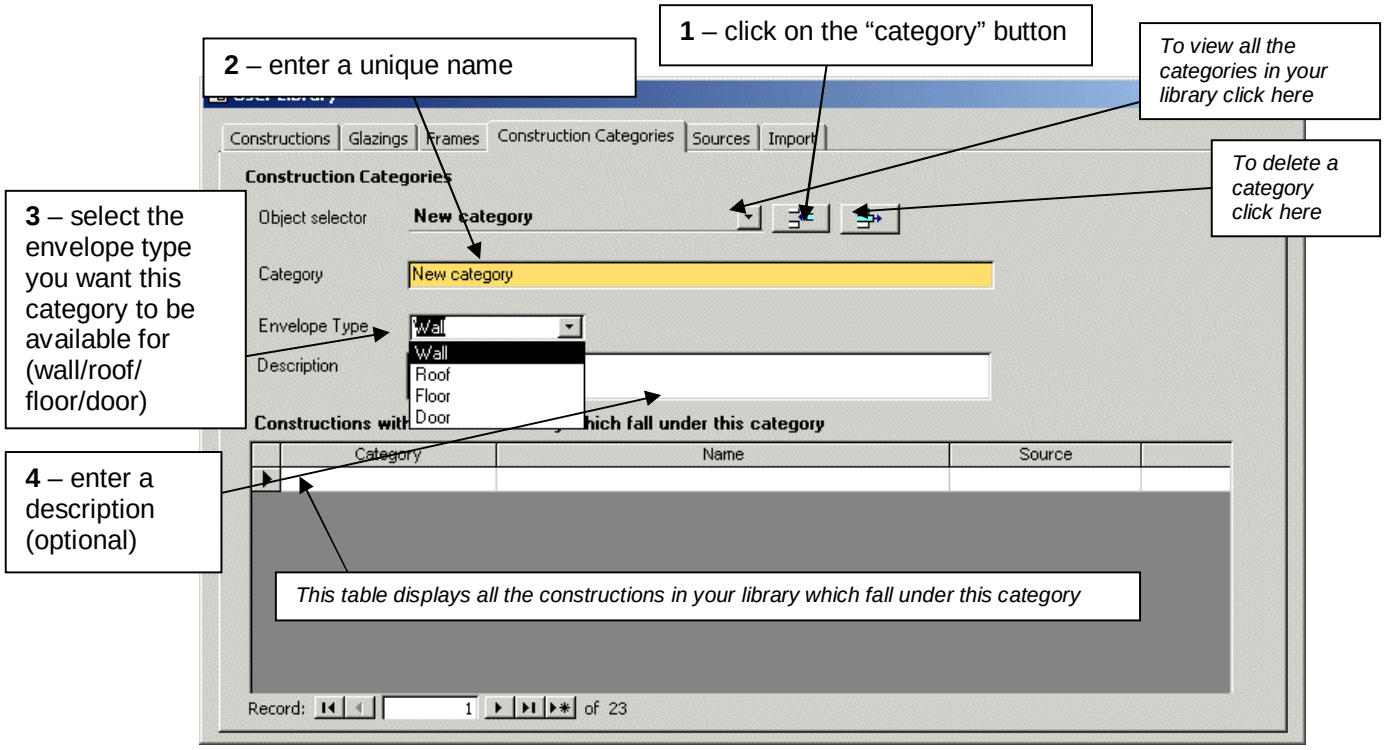


Figure 107: Description of Construction Categories tab in User-defined construction library

- ***Editing the list of sources which you can select when defining opaque constructions, glazing types, or frame types***

  The list is viewable and editable in the *Sources* form. To add a new source, click on the "enter new source" button and write the name of the source in the source field. This source will now be available for selection in the *Construction*, *Glazing*, and *Frames* form.

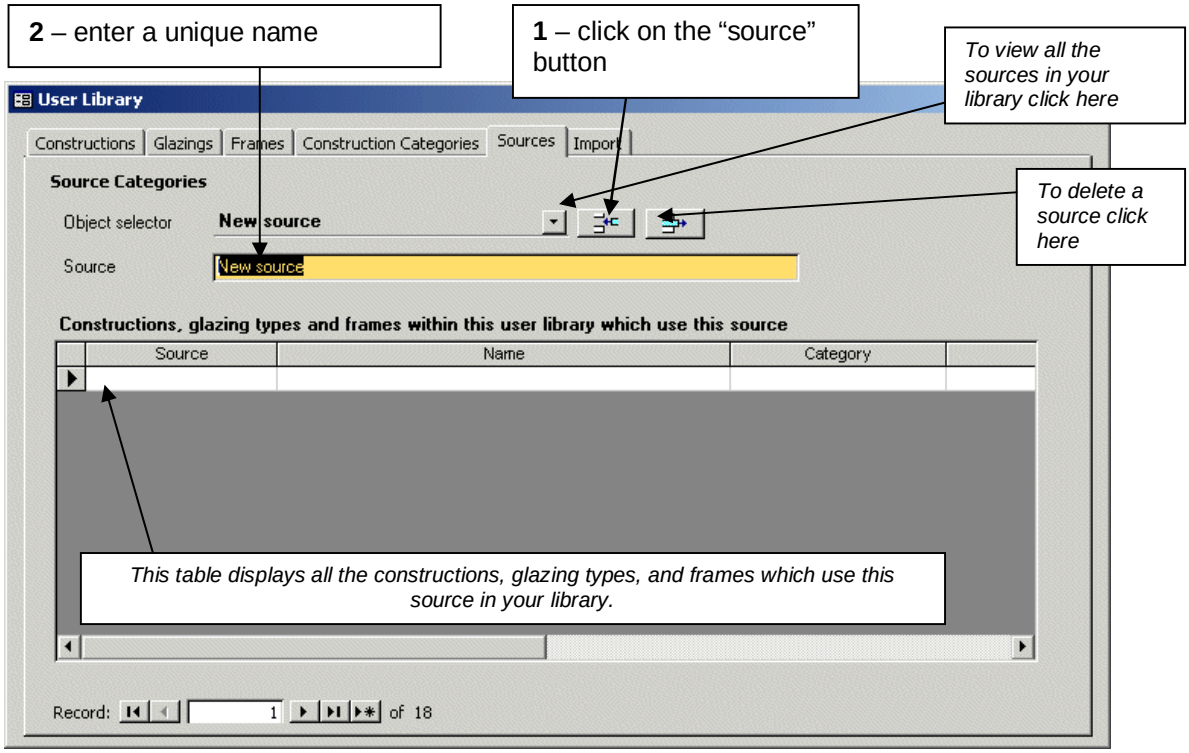


Figure 108: Description of Sources tab in User-defined construction library

5. How to import constructions previously entered into an iSBEM project or in another User Library into your own User Library

You may wish to import constructions from an existing User Database into your own, for example, from a colleague's User Database. This can be done in the *Import* form. Similarly, In iSBEM, there is already a library of constructions which you can choose from in the *Project Database* form. If you wanted to edit any of these, you could import these into your User Library. This is done by selecting the mdb (User Database) file or nct (iSBEM file) and clicking on the appropriate import button as shown in Figure 109.

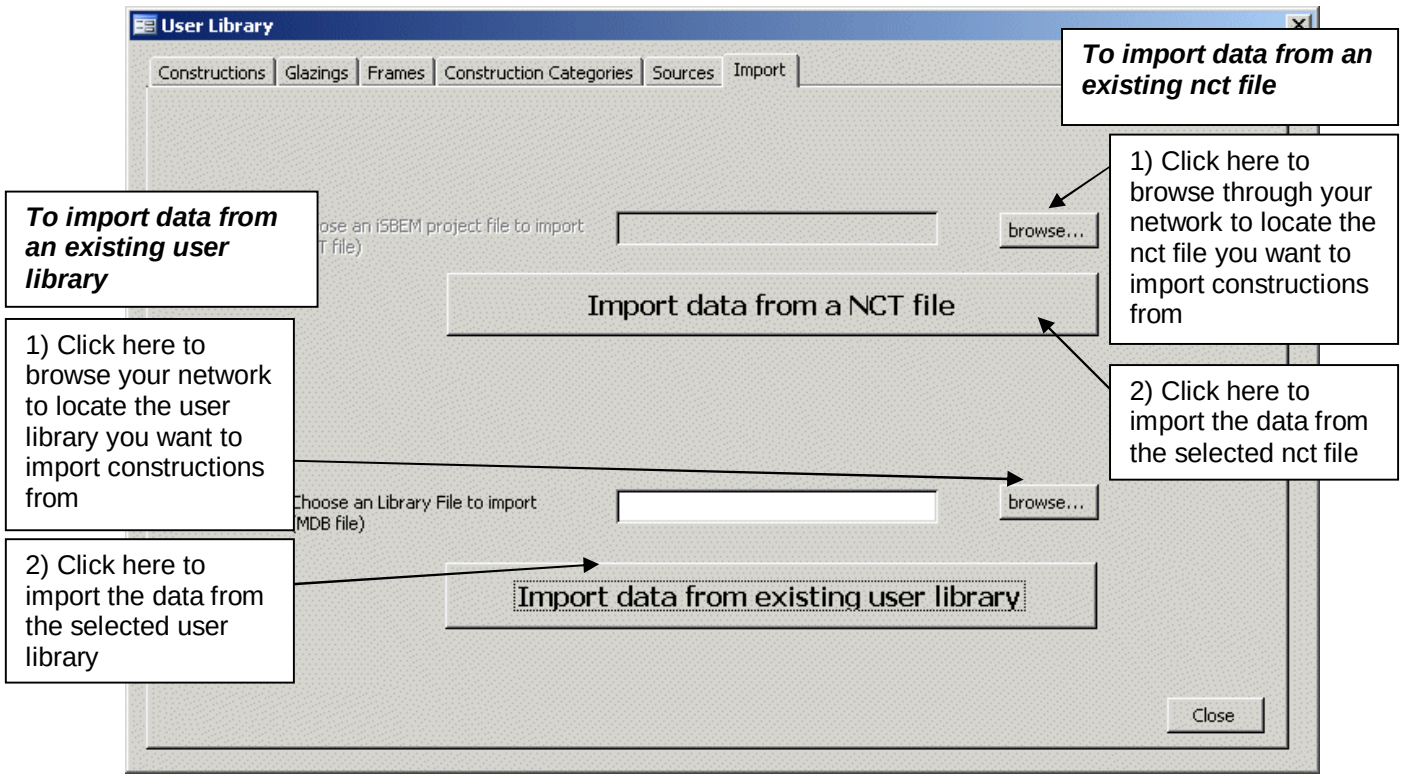

User Library
Constructions
Glazings
Frames
Construction Categories
Sources
Import
To import data from an existing nct file
1) Click here to browse through your network to locate the nct file you want to import constructions from
To import data from an existing user library
ose an iSBEM project file to import
T file)
browse...
Import data from a NCT file
2) Click here to import the data from the selected nct file
1) Click here to browse your network to locate the user library you want to import constructions from
Choose an Library File to import
(MDB file)
browse...
2) Click here to import the data from the selected user library
Import data from existing user library
Close

Figure 109: Description of Import tab in User-defined construction library

Once this procedure is successfully completed, these records will be available for editing within the User Library tool, and should also be automatically available for use within iSBEM without any further updates needing to be carried out.

NB: All user-updated constructions, glazings, and frames from the User Library (including those that have been imported) will have the prefix "§ " added to them (unless it already exists, in which case an additional § will NOT be added).

NB: Should a construction/glazing/frame of the same name as an existing construction/glazing/frame be imported into the User Library, a number will be appended to the end of it, according to the number of records in the User Library with a similar name, i.e., a record with name *Name* will have its name changed to *Name.1*, *Name.2*, *Name.3,* etc. depending on whether there are already 1, 2, 3, etc. records in the database already with a similar name (excluding the suffix).

NB: Frames cannot be imported from NCT files due to the nature of their table layouts. Only constructions and glazings can be imported by this procedure.

APPENDIX D: List of parameters required by iSBEM

Form: General

Tab: General Information

Sub-tab: Project details

- Purpose of analysis
- EPC in Welsh? *(field enabled only for EPC Wales)*
- Additionally check Building regulations? *(field enabled only when one of the EPC generation options is selected as purpose of analysis)*
- Weather (location)
- Stage of analysis *(field not enabled for Scottish Building Regulations)*
- Project complexity *(field enabled only for England, Wales, and Northern Ireland EPCs)*
- Related party disclosure *(field enabled only for England, Wales, and Northern Ireland EPCs)*
- Transaction type *(field enabled only for England, Wales, and Northern Ireland EPCs)*
- S6 type of Building *(field enabled only for Scottish Building Regulations and Scotland EPC)*
- Is the building fully naturally ventilated and calculations confirm it would not overheat without the need for any mechanical ventilation? *(field enabled only for Scottish Building Regulations and Scotland EPC)*
- Rating with improvements *(field enabled only for Scotland EPC)*

Sub-tab: Building details

- Building type
- Name of project
- Building address
- City
- Postcode
- Location description
- UPRN *(field enabled only for England, Wales, and Northern Ireland EPCs)*
- Inspection date *(field enabled only for England, Wales, and Northern Ireland EPCs)*
- Is building of special conservation status? *(field enabled only for England, Wales, and Northern Ireland EPCs)*

Sub-tab: Certifier's / Energy Assessor's / Agent's / Qualified/Accredited Person's details

Sub-form: Certifier's / Energy Assessor's / Agent's / Qualified/Accredited Person's details

- Name
- Telephone number
- Address
- City
- Postcode
- Assessor number/Membership number *(field enabled only when one of the EPC generation options is selected as purpose of analysis)*
- Accreditation Scheme / Protocol Organisation *(field enabled only when one of the EPC generation options is selected as purpose of analysis)*
- EPCgen.net Activation Code *(field enabled only for England, Wales, and Northern Ireland EPCs)*
- Qualifications *(field enabled only for England, Wales, and Northern Ireland EPCs)*
- Employer/Trading name *(field enabled only when one of the EPC generation options is selected as purpose of analysis)*

- Employer/Trading address *(field enabled only when one of the EPC generation options is selected as purpose of analysis)*

Sub-form: Insurance details *(sub-form enabled only for England, Wales, and Northern Ireland EPCs)*

- Insurance Company
- Policy Number
- Policy start/effective date
- Policy end/expiry date
- Policy cover limit

Sub-tab: Owner's details

- Name
- Telephone number
- Address
- City
- Postcode

Form: Project Database

Tab: Construction for walls

Sub-tab: General

- Name of construction
- Does it involve metal cladding?
- Globally used in walls that connect zone to
- Definition of construction of walls using one of the following 3 options:

  1) Library
     - Category
     - Library

  or

  2) Inference procedures
     - Building sector
     - Building Regulations compliance
     - General description

  or

  3) Enter parameters manually
     - U-value [W/m^2K]
     - κ_m [kJ/m^2K]

Tab: Construction for roofs

Sub-tab: General

- Name of construction
- Does it involve metal cladding?
- Globally used in roofs that connect zone to
- Definition of construction of roofs using one of the following 3 options:

  1) Library
     - Category
     - Library

  or

  2) Inference procedures
     - Building sector
     - Building Regulations compliance
     - General description

  or

  3) Enter parameters manually
     - U-value [W/m^2K]
     - κ_m [kJ/m^2K]

Tab: Construction for floors

Sub-tab: General

- Name of construction

- Globally used in floors that connect zone to
- Definition of construction of floors using one of the following 3 options:

  1) Library
     - Category
     - Library

  or

  2) Inference procedures
     - Building sector
     - Building Regulations compliance
     - General description

  or

  3) Enter parameters manually
     - U-value [W/m^2K]
     - κ_m [kJ/m^2K]
     - Has the U-value been corrected to account for heat loss through floors in contact with the ground?

Tab: Construction for doors

Sub-tab: General

- Name of construction
- Definition of construction of doors using one of the following 3 options:

  1) Library
     - Category
     - Library

  or

  2) Inference procedures
     - Building sector
     - Building Regulations compliance
     - General description

  or

  3) Enter parameters manually
     - U-value [W/m^2K]
     - κ_m [kJ/m^2K]

Tab: Glazing

Sub-tab: General

- Name of construction
- Definition of construction of glazing using one of the following 3 options:

  1) Library
     - Category
     - Library

  or

  2) Inference procedures
     - Building Regulations compliance
     - Number of panes
     - Coating
     - Frame material

  or

  3) Enter parameters manually
     - U-value - for glazing in vertical inclination [W/m^2K]
     - T-solar – for normal incidence
     - L-solar – for normal incidence

Form: Geometry

Tab: Project

Sub-tab: General & Geometry

- Global air permeability at 50pa [$m^3/h.m^2$]
- Building (clockwise) rotation [degrees]
- Global zone floor-to-floor height [m]

- Building area [m^2]
- Is the building designed and built following the guidance in Accredited Construction Details (Scotland)? *(field enabled only for Scottish Building Regulations)*

Sub-tab: Thermal Bridges

- Global Psi value [W/mK] for junctions involving metal cladding for each of:
  - Roof-Wall
  - Wall-Ground floor
  - Wall-Wall (corner)
  - Wall-Floor (not ground floor)
  - Lintel above window or door
  - Sill below window
  - Jamb at window or door
- Global Psi value [W/mK] for junctions not involving metal cladding for each of:
  - Roof-Wall
  - Wall-Ground floor
  - Wall-Wall (corner)
  - Wall-Floor (not ground floor)
  - Lintel above window or door
  - Sill below window
  - Jamb at window or door

Tab: Zones

Sub-tab: General

- Zone name
- HVAC system which serves the zone
- Building type
- Activity type in the zone
- Zone area [m^2]
- Zone floor-to-floor height [m], or select global value
- Air permeability at 50pa [$m^3/h.m^2$] in the zone, or select global value
- Zone multiplier
- Description of zone
- Define the following Psi values for thermal bridges in the zone or use global values?
  - Zone Psi value [W/mK] for junctions involving metal cladding for each of:
    - Roof-Wall
    - Wall-Ground floor
    - Wall-Wall (corner)
    - Wall-Floor (not ground floor)
    - Lintel above window or door
    - Sill below window
    - Jamb at window or door
  - Zone Psi value [W/mK] for junctions not involving metal cladding for each of:
    - Roof-Wall
    - Wall-Ground floor
    - Wall-Wall (corner)
    - Wall-Floor (not ground floor)
    - Lintel above window or door
    - Sill below window
    - Jamb at window or door

Tab: Envelopes

Sub-tab: General

- Envelope name
- Zone which envelope belongs to
- Type of envelope

    - Is it a flat roof? *(field enabled if envelope type is roof)*
- Envelope connects space to, or select global value
- Envelope construction
- Envelope area [m^2]
- Envelope orientation
- Definition of any thermal bridges in the envelope additional to global values
    - Thermal bridge multiplier
    - Thermal bridge length [m]
    - Thermal bridge Psi [W/mK]
    - Thermal bridge description

Tab: Doors

Sub-tab: General

- Door name
- Envelope which door is in
- Door type
- Door construction
- Door area [m^2]
- Definition of any thermal bridges in the door additional to global values
    - Thermal bridge multiplier
    - Thermal bridge length [m]
    - Thermal bridge Psi [W/mK]
    - Thermal bridge description

Tab: Windows & Rooflights

Sub-tab: General

- Window/Rooflight name
- Envelope which window/rooflight is in
- Glazing type
- Window/Rooflight projected area [m^2]
- Ratio of developed area to projected area of window/rooflight
- Ratio of roof area covered by rooflight array to area of rooflight glazing
- Is it a display window?
- Frame factor
- Shading system on window/rooflight
- Transmission factor due to fins and overhangs
- Definition of any thermal bridges in the window/rooflight additional to global values
    - Thermal bridge multiplier
    - Thermal bridge length [m]
    - Thermal bridge Psi [W/mK]
    - Thermal bridge description

Form: Building Services

Tab: Global and Defaults

Sub-tab: HVAC System Defaults *(sub-tab enabled for EPC calculations only)*

- Fuel type for default Heating only – Other systems
- Fuel type for default Heating and mechanical cooling systems

Sub-tab: Project building services

- Do the lighting systems have provision for metering? *(field not enabled for Scottish Building Regulations)*
    - Is there monitoring and testing with alarm for out-of-range values? *(field enabled if lighting systems have provision for metering)*
- Does the building have a lighting voltage reduction management scheme? *(field enabled only for Scottish Building Regulations)*
- Electric power factor

- The CO_2 emission factor for the district heating network. *(field enabled only if the heat source and fuel type of any of the HVAC systems is set to be district heating)*
- The primary energy factor for the district heating network. *(field enabled only if the heat source and fuel type of any of the HVAC systems is set to be district heating)*

Sub-tab: Air Conditioning Inspection *(sub-tab enabled for EPC calculations but not for EPC Scotland)*

- Does the building have an air conditioning system?
  - Is the actual output unknown?
    - § Total effective rated output of the air conditioning system [kW]

    or
    - § Estimated total effective rated output of the air conditioning system
  - Has an air conditioning inspection been commissioned for compliance with Energy Performance of Buildings regulations?

Tab: HVAC Systems

Sub-tab: General

- HVAC system name
- HVAC system type
  - Heat recovery in ventilation system *(field enabled if there is mechanical ventilation at HVAC level)*
    - § Heat recovery seasonal efficiency

Sub-tab: Heating System

- Heat source
- Fuel type for heat generator
- Does this heating system use variable speed pumping? *(field enabled only if the heating system is central using water)*
- Does this heating system also use CHP?
- Effective heat generating seasonal efficiency for heat generator
- Heat generator radiant efficiency *(field enabled if HVAC is a radiant system)*
- Does the heating system qualify for ECA *(relevant only if default efficiency value is used)*?
  - Was the heating system installed in or after 1998 *(relevant only if default efficiency value is used)*?

Sub-tab: Cooling System *(enabled only if HVAC system provides cooling)*

- Generator type
- Generator kW
- Fuel type for cooling generator
- Seasonal energy efficiency ratio for cooling generator
- Nominal energy efficiency ratio for cooling generator
- Does the cooling system qualify for ECA *(relevant only if default efficiency value is used)*?
- Does the system have mixed mode operation strategy?

Sub-tab: System adjustment *(enabled only if there is mechanical ventilation at HVAC level)*

- Has the ductwork been leakage tested?
  - CEN classification it meets
- Does the AHU meet CEN leakage standards?
  - CEN classification it meets
- Specific fan power [W/(l/s)]
- Ratio of kWh of auxiliary energy to kWh of heating energy *(field enabled if HVAC is a fanned warm air heater)*

Sub-tab: Metering Provision

- Does the HVAC system have provision for metering? *(field not enabled for Scottish Building Regulations)*

- Is there monitoring and testing with alarm for out-of-range values? *(field enabled if HVAC system has provision for metering)*

Sub-tab: System Controls *(sub-tab enabled only when one of the EPC generation options is selected as purpose of analysis)*

- Does the HVAC system have central time control?
- Does the HVAC system have optimum stop/start control?
- Does the HVAC system have local time control?
- Does the HVAC system have local temperature control?
- Does the HVAC system have weather compensation control?

Tab: HWS

Sub-tab: General

- HWS name
- HWS generator type
  - Fuel type for HWS generator *(field enabled if hot water is not generated by HVAC system)*
  - Effective heat generating seasonal efficiency for HWS generator *(field enabled if hot water is not generated by HVAC system)*
  - Was the HWS installed later than 1998 *(relevant only if default efficiency value is used)*? *(field enabled if hot water is not generated by HVAC system)*

Sub-tab: Storage & Secondary Circulation

- Is the system a storage system?
  - Storage volume [litres]
  - Insulation type on storage vessel
    - § Insulation thickness [mm]

  or
  - Storage losses [MJ/month]
  - Does the system have secondary circulation?
    - § Circulation losses [W/m]
    - § Pump power [kW]
    - § Loop length [m]
    - § Is there time control on the secondary circulation?

Tab: SE Systems

Sub-tab: Collector Parameters

- SES name
- HWS which SES is in
- SES area [m^2]
- SES multiplier
- SES orientation
- SES inclination [degrees]
- Do you know the collector performance parameters according to EN 12975-2?
  - Zero-loss collector efficiency factor
  - Collector heat loss coefficient [W/m^2K]
  - Temperature dependence of heat loss coefficient [W/m^2K]
  - Incidence angle modifier of collector

Sub-tab: Solar Storage & Collector Loop

- Solar storage volume [litres]
- Solar pre-heating type
  - Insulation type on storage vessel
    - § Insulation thickness [mm]
- Do you know the heat transfer rate of the heat exchanger(s) in the collector loop?
  - Heat transfer rate [W/K]
- Do you know the overall heat loss coefficient of all pipes in the collector loop?
  - Heat loss coefficient [W/K]

Sub-tab: Auxiliary Energy & Distribution Losses

- Are the distribution pipes between the solar energy system and the back-up system insulated? *(field enabled only if the solar pre-heating type is a separate solar cylinder)*
- Circulation system
  - Do you know the nominal power of the pumps?
    - § Nominal power of the pumps [W]

Tab: PV Systems

Sub-tab: General

- PVS name
- PVS type
- PVS area [m^2]
- PVS multiplier
- PVS orientation
- PVS inclination [degrees]

Tab: Wind Generators

Sub-tab: General

- Wind generator name
- Terrain type
- Horizontal axis?
  - Diameter of blades [m]
- Other axis?
  - Area swept by blades [m^2]
- Hub height [m]
- Wind generator power [kW]

Tab: CHP Generator

Sub-tab: General

- Fuel type
- Heat efficiency
- Electrical efficiency
- CHPQA Quality Index
- % of building space heat supplied by CHP
- % of building hot water supplied by CHP
- Is it a tri-generation system?
  - % of building space cooling supplied by CHP
  - Chiller efficiency

Tab: Zones

Sub-tab: HVAC, HWS, and Lighting systems

- HVAC system which services the zone
- Are there de-stratification fans in the zone?
- HWS which serves the zone
- Dead leg length for HWS in the zone [m]

Sub-tab: Ventilation

- Zonal ventilation system – natural or mechanical *(field enabled if there is no mechanical ventilation at HVAC level)*
  - Heat recovery in the zone ventilation (*field enabled if there is mechanical ventilation at zone level)*
    - § Heat recovery seasonal efficiency
  - Specific fan power for supply & extract [W/(l/s)] (*field enabled if there is mechanical ventilation at zone level)*
- Does activity require high pressure drop air treatment?

Sub-tab: Exhaust

- Is there mechanical exhaust in the zone?
  - Flow rate of mechanical exhaust [l/s.m^2]
  - Specific fan power for exhaust [W/(l/s)]
  - Extract system serves single or multiple rooms?

Sub-tab: Lighting (General)

- Provide information on lighting using one of the following 3 options:

1) Full lighting design
    - Total wattage [W]
    - Design illuminance [lux]

or

2) Lumens per circuit wattage (not available for office, industrial, and storage areas in all building types)

or

3) Lamp type

- Does display lighting use efficient lamps? *(field enabled for activities with display lighting)*
    - Lumens per circuit wattage for display lighting
- Are air-extracting luminaries fitted?

Sub-tab: Lighting (Controls)

- Type of lighting controls in the zone
    - Local manual switching?
    - Photoelectric?
        - Dimming or switching?
        - Type of sensors?
        - Different sensor for back of zone?
        - Parasitic power for photoelectric control
    - Do you want SBEM to perform automatic daylight zoning for lighting controls?
        - Percentage area of zone where lighting is controlled by daylight.
- Type of occupancy sensing in the zone
    - Parasitic power for occupancy sensing

Sub-tab: Display Lighting

- Does display lighting use efficient lamps? *(field enabled for activities with display lighting)*
    - Lumens per circuit wattage for display lighting
- Are air-extracting luminaries fitted?
- Is there time-switching for display lighting? *(field enabled for activities with display lighting)*
    - Hours off
    - Fraction off

Further guidance

APPENDIX E: Activation codes and connection to EPCgen.net

Emails containing activation codes for accredited energy assessors are sent via an automatic process and should not take longer than a few minutes. If you do not receive this email, you should check the following:

- Ensure that your computer is connected to the internet while running the EPC calculation.
- If applicable, ensure that you have entered the proxy server details correctly into iSBEM. Contact your IT department for assistance on your correct proxy server settings.
- If applicable, ensure that the firewall settings on your computer system allow access to the EPCgen.net website. Contact your IT department for assistance on your firewall settings. The websites and IP addresses that your firewall will need to allow access to are:
    - www.epcgen.net - IP: 209.62.38.248
    - www.ndepcregister.com - IP: 81.168.117.62
    - www.epbniregisternd.com - IP: 81.168.117.59
- Ensure that your name is on the National Register of accredited non-domestic energy assessors (www.ndepcregister.com for England and Wales and www.epbniregisternd.com for Northern Ireland), that your details, especially your email address, are valid and up to date, and that the name of your Accreditation Scheme Provider is correctly spelt. If any of these details need amendment, contact your Accreditation Scheme Provider.
- Ensure that the settings in your email account have not flagged up the activation code email as “junk” and discarded it to the “Delete bin”.
- Ensure that the EPC calculation in iSBEM has completed successfully (i.e., that it has not crashed with any errors before completion). If not, examine the error files (.err) and correct the errors before proceeding. You can contact your Accreditation Scheme Provider for assistance.
- If you have followed all the above guidance and still have not received the email with the activation code, contact your Accreditation Scheme Provider.

Once you receive your activation code email, you should ensure the following:

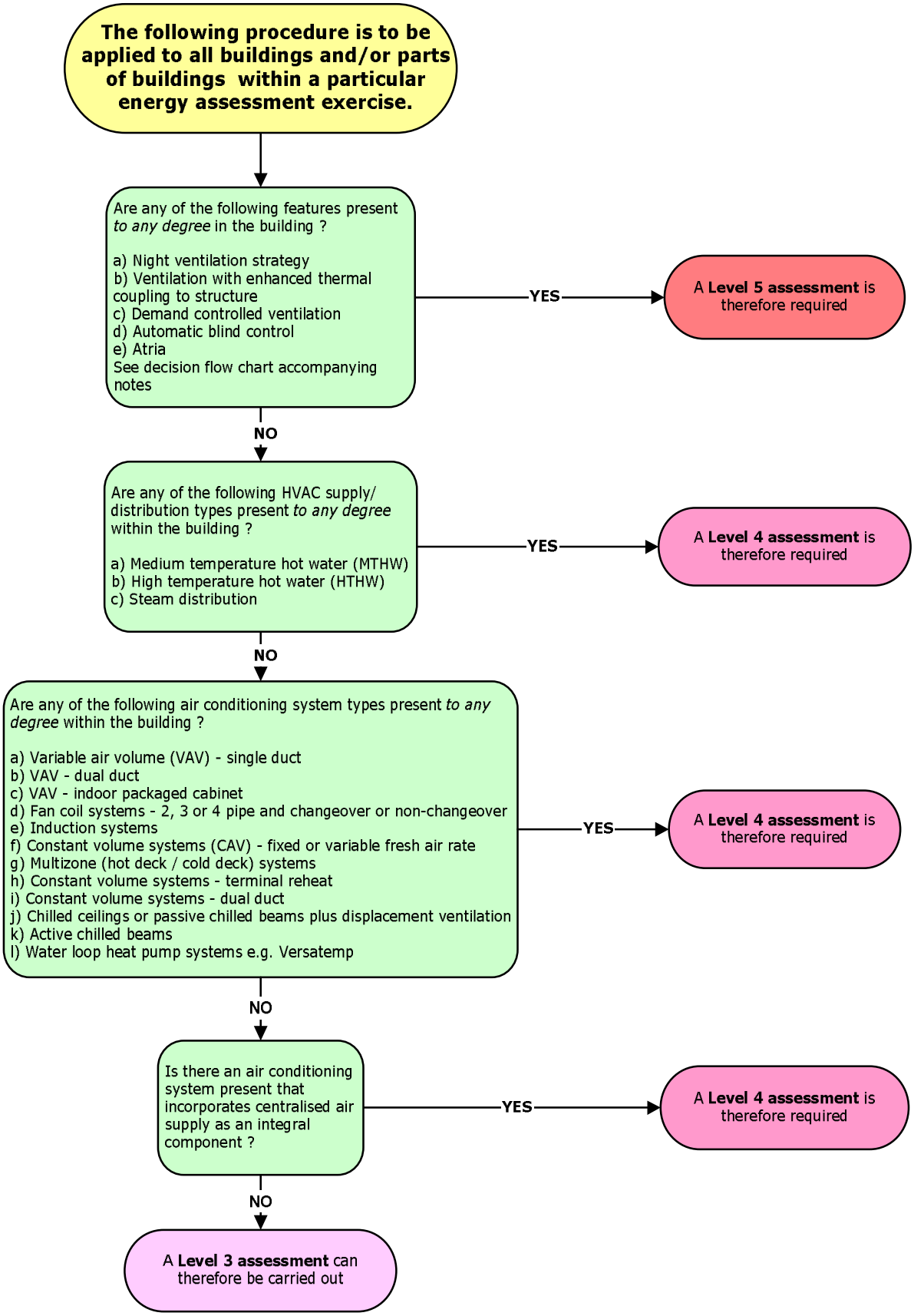
- Insert the activation code into iSBEM exactly as it appears in the email, for e.g., do not confuse the letter O with the number 0.
- Keep your activation code email safe. If you lose it, contact your Accreditation Scheme Provider.
- As above, when running the calculation with the activation code (in order to produce the XML message and the EPC documents without the watermarks), ensure that your computer is connected to the internet with any applicable proxy server and firewall details correctly set.

APPENDIX F: Matrix of activity areas and building types

| Building Types/Activities | Cellular office | Open plan office | Storage area | Circulation (corridors and stairs) (- non public) | Toilets | Tea making | Reception | Meeting room | Dry sports hall | Changing facilities | Swimming pool | Food preparation area | Hall/lecture theatre/assembly area | Laboratory | Waiting room | Consulting room | Operating theatre | Patient accomodation (wards) | Bathroom | Bedroom | Eating/drinking area | Sales area - general | Sales area -chilled | Storage - chilled | Display area | Performance area (stage) | Plant room | Workshop - small scale | Industrial process area | Cell (police/prison) | High density IT work space | IT equipment | Laundry | Common room/staff room/lounge | Security check area | Baggage reclaim area | Check-in area | Circulation (public areas) | Warehouse storage | Warehouse storage - chilled | Domestic lounge | Domestic kitchen | Domestic toilets | Domestic dining room | Domestic bathroom | Domestic bedroom | Domestic circulation | Warehouse sales - general | Warehouse sales - chilled | Warehouse sales - electrical | Fitness suite/gym | Fitness studio | Sales area - electrical | Ice rink | Classroom | Hydrotherapy Pool | Storage area - cold room (<0oC) | Intensive care/high dependency | Diagnostic Imaging | Ward offices | Ward staff room/day room/lounge | A&E consulting/treatment | Physiotherapy | Speculative office | Speculative retail space | Speculative industrial space | Post Mortem | Day Patient Accommodation | Data centres | Common circulation areas |
|---|---|---

NEW

APPENDIX G: Agreed convention for decision on assessment level


The following procedure is to be applied to all buildings and/or parts of buildings within a particular energy assessment exercise.
Are any of the following features present *to any degree* in the building ?
a) Night ventilation strategy
b) Ventilation with enhanced thermal coupling to structure
c) Demand controlled ventilation
d) Automatic blind control
e) Atria
See decision flow chart accompanying notes
YES
A **Level 5 assessment** is therefore required
NO
Are any of the following HVAC supply/ distribution types present *to any degree* within the building ?
a) Medium temperature hot water (MTHW)
b) High temperature hot water (HTHW)
c) Steam distribution
YES
A **Level 4 assessment** is therefore required
NO
Are any of the following air conditioning system types present *to any degree* within the building ?
a) Variable air volume (VAV) - single duct
b) VAV - dual duct
c) VAV - indoor packaged cabinet
d) Fan coil systems - 2, 3 or 4 pipe and changeover or non-changeover
e) Induction systems
f) Constant volume systems (CAV) - fixed or variable fresh air rate
g) Multizone (hot deck / cold deck) systems
h) Constant volume systems - terminal reheat
i) Constant volume systems - dual duct
j) Chilled ceilings or passive chilled beams plus displacement ventilation
k) Active chilled beams
l) Water loop heat pump systems e.g. Versatemp
YES
A **Level 4 assessment** is therefore required
NO
Is there an air conditioning system present that incorporates centralised air supply as an integral component ?
YES
A **Level 4 assessment** is therefore required
NO
A **Level 3 assessment** can therefore be carried out

NEW

Accompanying Notes to Assessment Level Decision Flow Chart including agreed definitions

Air Permeability

Air permeability is expressed as volume flow per hour (m^3/h) of air supplied to the space per square metre (m^2) of envelope area for an internal to external pressure difference of 50 Pa, i.e., 25 m^3/hm^2 at 50Pa.

Atrium

In this context, a non-continuously occupied interior space within a building, often several storeys high, bounded on at least one side by occupied spaces set to the conditions determined from the activity database. There may or may not be building elements (such as glazing) surrounding the atrium (although there may need to be something for smoke control in case of fire). The atrium itself is not maintained to the conditions set by the activity database for adjoining spaces. The technical purpose of the atrium can be one or more of the following:

- Providing a buffer between the thermal conditions in the adjoining spaces and the exterior, to reduce the direct impact of the exterior on those zones. In this case, it should not be maintained to conditions as though it is occupied. (If it is conditioned and the features below do not apply, in this context, it is not considered to be an atrium.)
- Providing a means for daylight to reach the middle of deep plan spaces that would otherwise not receive it
- Encouraging stack effect or other passive ventilation to draw extract air from the adjoining spaces.

Automatic Blind Control

In this context, internal or inter-pane (but not exterior) blinds that are motorised so that the position can be modified to control solar heat gain and/or glare, controlled by automatic sensors. The control regime must also open the blinds as the heat gain and/or daylight levels decrease, so that the use of these natural resources can be optimised for each zone. Note that exterior shading devices can be modelled using iSBEM in the definition of each window; however SBEM currently does not model the re-radiation effects of blinds where solar gain has entered the space before it is modulated by the shading device.

Demand-Controlled Ventilation

Is defined as supply and/or extract ventilation that is modulated to match the needs of the actual occupation level of each zone, rather than operating at a constant level defined by the activity database. Thus the energy required to adjust the condition of the supply air and that required to move the air can be reduced. The rate of ventilation would typically be controlled by presence detectors, CO_2 sensors, or another device that senses the varying requirement.

Lightwell

A lightwell is a space surrounded by the walls of a building but that has no roof or glazing above it. It is, therefore, similar to a courtyard in appearance. The walls that surround the lightwell are exposed to external air.

Night Ventilation Strategy

Can be defined as the presence of suitable systems, controls, and operating strategy such that overnight ventilation (passive and/or mechanical) is used to cool down the exposed building mass and, thereby, offset daytime cooling demands. If no such operation and subsequent offset is possible through the automatic operation of systems and controls, then night ventilation strategy is deemed to be not present as part of the building energy asset rating.

Sunpipes

A sunpipe is a tube/pipe, consisting of internal reflective surfaces, which channels daylight to an internal area.

Ventilation with Enhanced Thermal Coupling to Structure
This is a further development of the ‘night ventilation’ strategy such that significant components of the building structure, in addition to its ordinary surfaces, are exposed to night ventilation, in order to enhance the building's capability of offsetting daytime cooling demands. An example of this procedure is the TermoDeck system where night ventilation is passed through ducts in the solid floors of the building, thereby, increasing the 'coolth' contained in the thermal capacity of the building structure available to offset subsequent summertime daytime cooling loads.

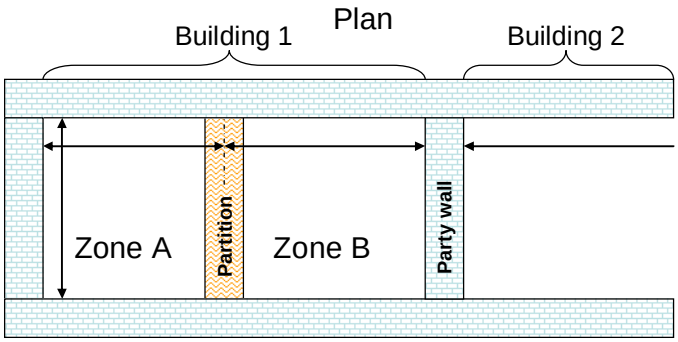
NEW

APPENDIX H: Agreed convention for determining dimensions

Horizontal dimensions

Consider

- Plan view of two buildings in a terrace
  - Separated by a party wall
  - Building 1 has two zones
- Wall types
  - "Perimeter" surrounds each building (external and party walls)
  - "Internal" refers to walls within each building (partitions)



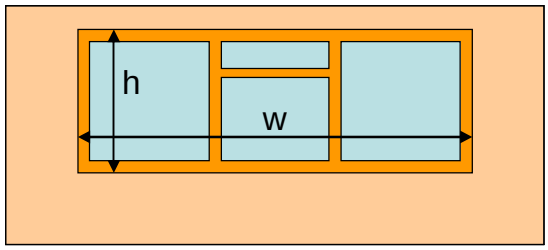
Generally follow RICS definition of Gross Internal Area

Need to measure

- Inside perimeter walls
- Mid point of internal walls
- Party walls are perimeter, so measure to surface, not mid point

Openings

- Inside structural opening (w x h)
- *Not just glass area*
- Percentage glazing is as viewed from inside
  - ie percentage of wall area to full zone height (defined below)

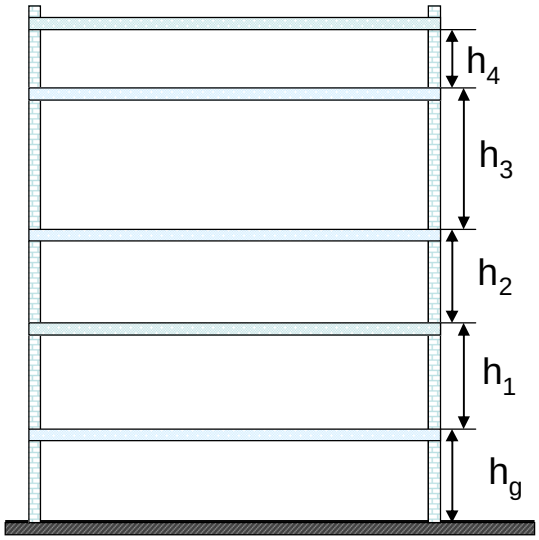


- 100% Glazing
  - Enter a wall of total area
  - Enter glazing with same area (or as 100%)

Zone height and element areas

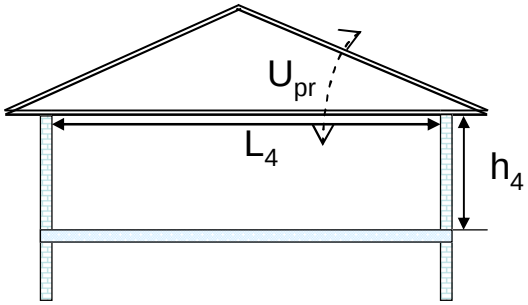
Generally zone height is top of slab to top of slab for ground and intermediate floors, or soffit/eaves level at roof level

- For ground and intermediate floors
  - Zone height is top of floor to top of floor
- For top floors with flat roof
  - Zone height is top of floor to soffit/underside of roof slab



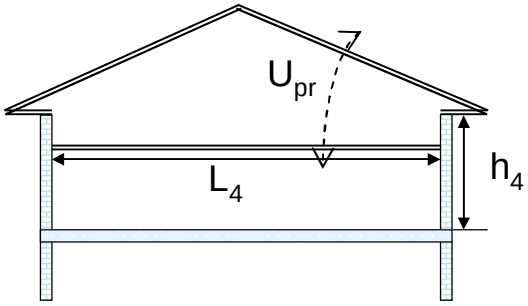
- For top floors with pitched roof but flat ceiling

  - Zone height is top of floor to underside of soffit/eaves level
  - U value is from under ceiling to outside roof including insulation wherever it is
    - that is, consistent with the area being entered
  - Area of gable wall is that below soffit/eaves level ie length L_4 x h_4



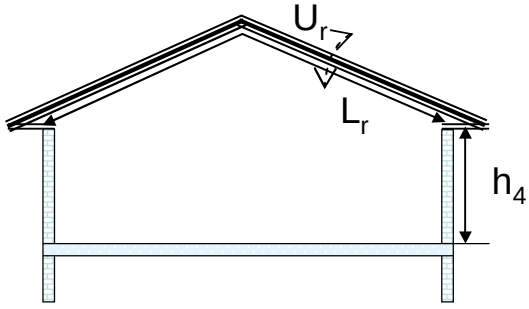
- For top floors with pitched roof and dropped ceiling with or without insulation at ceiling level

  - Zone height (h_4) is top of floor to underside of soffit/eaves level (not ceiling)
  - U value is from under ceiling to outside roof
  - Side and end wall areas are calculated to soffit/eaves level i.e. dropped ceiling is treated as though it is at soffit/eaves level
  - This convention has been adopted to avoid having to determine the relative levels of ceiling and soffit, and confusion over where the insulation is placed

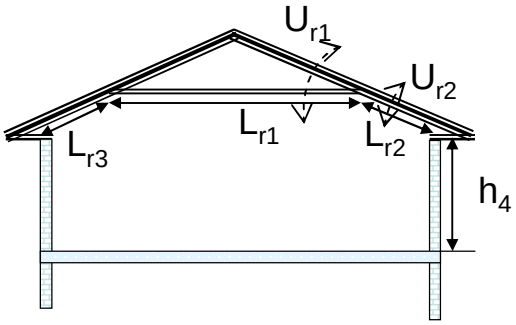


- For rooms with pitched ceiling (e.g. where ceiling is fixed in line of pitched roof)

  - Zone height (h_4) is top of floor to underside of soffit/eaves level *(not average room height)*
  - Roof heat loss area is as seen from underside of ceiling, i.e. L_r x d (zone depth)
  - U value is from under ceiling to outside roof (U_r)
  - End wall area is whole gable up to roof apex (as this is all exposed to inside temperature)

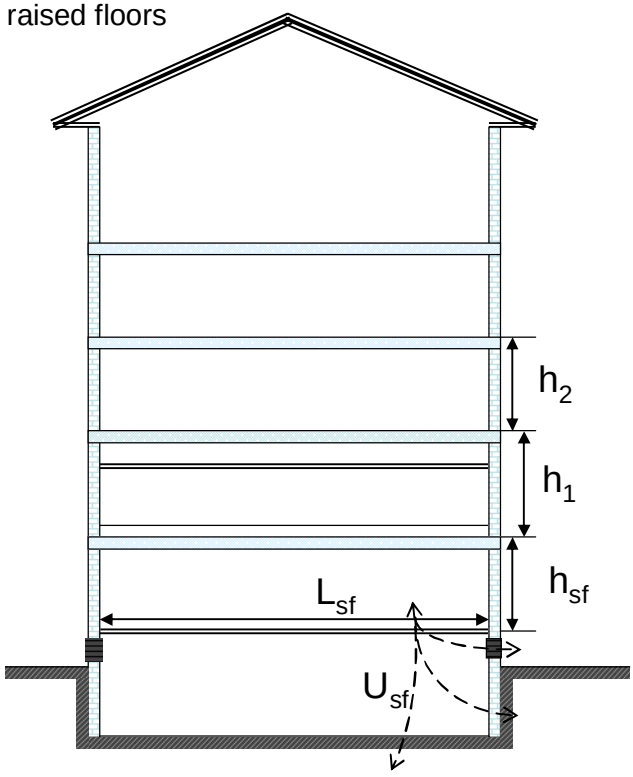


- If there is a horizontal ceiling half way up the pitched roof, split the area into
  - The part with a void (L_{r1}), using the U-value including the void (U_{r1})
  - The part where there is no void (L_{r2}, L_{r3}), using the U-value without a void (Ur2)
  - Zone height is still to underside of soffit/eaves level



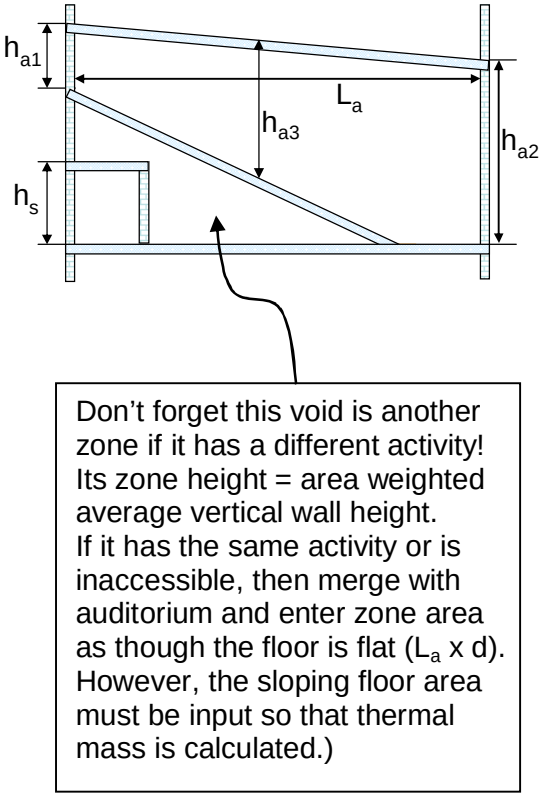
So the general rule is to **input the area exposed to the inside temperature, and the U-value between this surface and outside**, except for the dropped ceiling case.

- Intermediate floors with suspended ceilings and raised floors
  - Zone height is top of floor slab to top of next floor slab e.g. h_1
  - So, ignore the suspended ceilings and raised floors for the purposes of
    - zone height
    - surrounding wall areas
  - But include their impact on Kappa values of the slabs above and below so that thermal mass effects are calculated correctly
- With suspended timber ground floor and ventilated void below
  - Zone height is top of suspended floor surface to top of first floor surface (h_{sf})
  - Where the floor U value is calculated it should take account of the ventilated void (U_{sf})



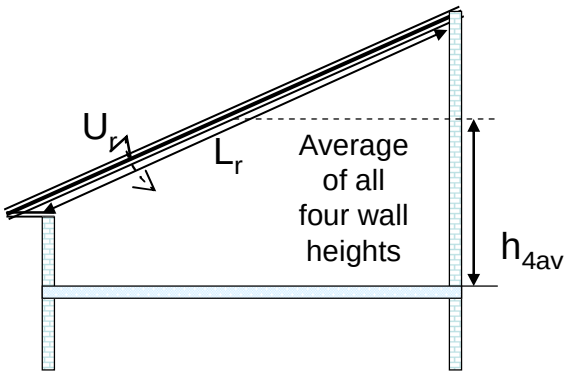
When there are walls of different heights to consider:

- For sloping floors and ceilings (eg auditoria)
  - If the activity above and under the floor is the same, or the void is inaccessible, choose normal zone height, otherwise
  - zone height = weighted average wall height h_{a1}, h_{a2}, h_{a3}, etc (from where floor adjoins each wall to top of floor above)
  - Zone area A_a is projected area/plan area as per RICS GIA standard
  - Make sure in addition that all external (and internal) wall and slab areas are input so that all heat loss/gain and thermal mass is calculated
  - ***Note that zoning for daylit areas must be carried out manually in these circumstances (do not use automatic daylight zoning)***


h_{a1}
L_a
h_{a3}
h_{a2}
h_s
Don't forget this void is another zone if it has a different activity! Its zone height = area weighted average vertical wall height. If it has the same activity or is inaccessible, then merge with auditorium and enter zone area as though the floor is flat (L_a x d). However, the sloping floor area must be input so that thermal mass is calculated.)

- For cubical rooms under the sloping floor
  - Zone height = top of slab to top of slab (h_s)
- Area weighted average wall height is defined as total wall area divided by horizontal perimeter length (eg $2L_a$ + 2 x depth (d) in the diagram)

- For rooms with mono-pitched ceiling
  - Zone height is top of floor to weighted average height of all walls - h_4
  - Area of roof (A_r) is as seen from underside i.e. L_4 x zone depth
  - U value from under ceiling to outside roof is U_r
  - Use total area of gable wall
  - ***Note that zoning for daylit areas must be carried out manually in these circumstances***



- If there is a horizontal ceiling under the mono-pitched roof
  - Level with or below eaves: zone height at eaves
  - Above eaves: zone height = average exposed wall height
  - Roof area would have to be divided into areas with different U-values with and without void

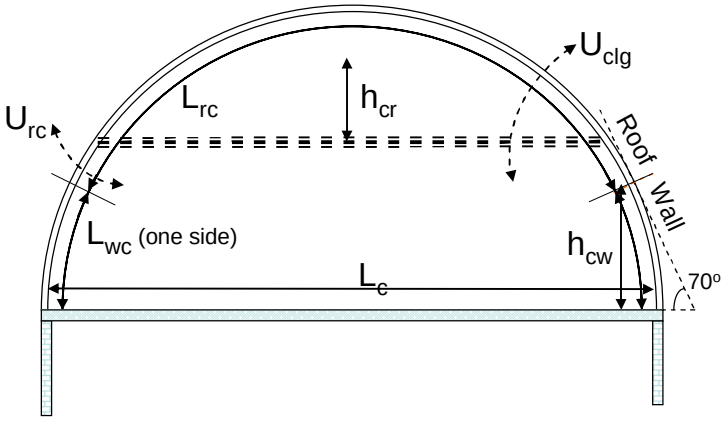
- Curved roof – for EPCs all buildings with curved roof sections shall be approximated as in the diagram:
  - Circular (not elliptical or other shapes)
  - Semi-circular so that width = 2 x height

  - Walls are 70-90^o from horizontal, roofs are <70^o
  - So zone height h_{cw} = dividing point between wall and roof, where slope = 70^o at "eaves"

  - If a floor (eg as shown dotted) meets roof at <70^o, there is no wall, so zone height h_{cr} = average height of space

  - If the dotted line represents the ceiling with an unoccupied void above, remember to input
    - the area of roof where the slope < 70^o between this ceiling and the "eaves", with its U value (U_{rc}), and
    - the flat ceiling with U value (U_{clg}) including the void above the ceiling

  - Treat dormer windows the same as for a room in a pitched roof (see below)



For consistency, the convention is to assume all such roofs are semi-circular.
If floor width = L_c and building depth is d
- Zone height h_{cw} = 0.171 x L_c
- Wall height L_{wc} = 0.175 x L_c
- Area curved walls = L_{wc} x d x 2 (both sides)
- Curved roof width L_{rc} = 1.222 x L_c
- Area curved roof = L_{rc} x d

- For room in roof (or mansard roof):
  - Areas and U values should correspond
  - U values for walls should include any voids – U_{w1}, U_{w2}
  - Zone height (h_{w1}) = height of vertical part of wall
  - If this varies, calculate area weighted average height

- Where there are dormer windows (ie window bays that project through the roof)
  - Do not adjust zone height for the dormer windows
  - Zone manually for daylit areas (if the glazing > 20% of vertical wall area)
  - Enter the glazing details and areas as normal
  - ***Note that zoning for daylit areas must be carried out manually in these circumstances***